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ABSTRACT

Prepared by Canadian, Chinese Taipei, and Thai educational agencies and based on surveys of Asia Pacific Economic Cooperation member nations, this report provides descriptions of 52 exemplary industrial technology training models in Australia, Brunei, Canada, Chinese Taipei, Hong Kong, Malaysia, New Zealand, the Philippines, the People's Republic of China, Singapore, Thailand, and the United States. Following background on the survey, common program features are reviewed, such as hands-on training activities, replication of industrial conditions, retraining workers in their regular jobs, involvement of the private sector, and on-site training. Descriptions are then provided for 52 programs, including information on program objectives, delivery, specialized resources, unique elements and benefits, the duration of training, the role of partners, and testimonials from local users or government officials. A program contact, including telephone number is also provided. Sample models described include the Centre for Temperate Agri-Food Training, offered by North-West Institute of Technical and Further Education in Australia, which trains approximately 1,000 students in food production and processing and includes articulation with the University of Tasmania; Aircraft Maintenance Technician Training at Maktab Teknik Sultan Saiful Rijal in Brunei which has close cooperation with the national Air Force and airline; and the Workers' Institute of Technology in Malaysia, developed and maintained by trade unionists and offering three-year technical diplomas and two-year certificates. (KP)

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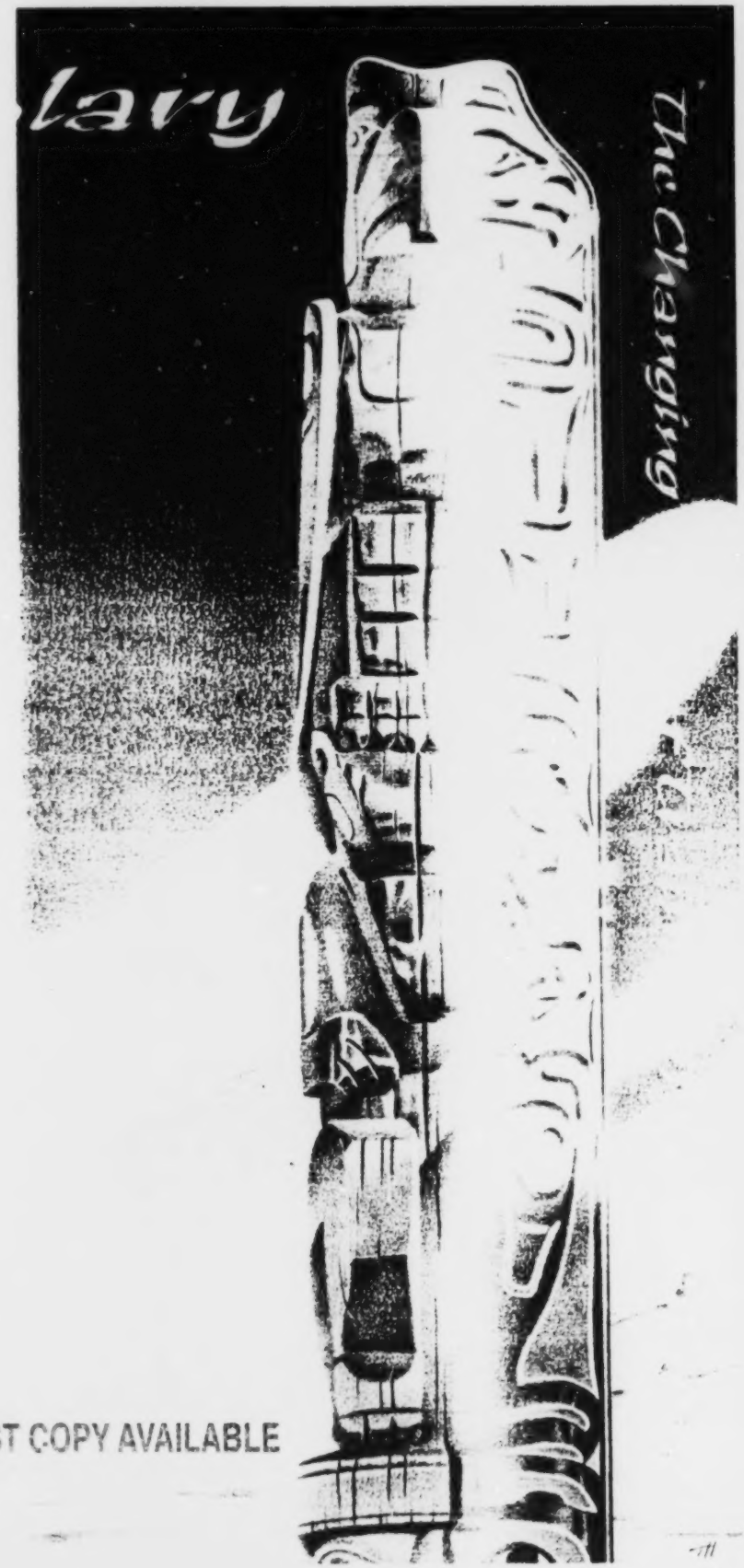
TRAINING MODELS IN INDUSTRIAL TECHNOLOGY



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APEC HUMAN RESOURCE DEVELOPMENT NETWORK PROJECT

ASIA PACIFIC ECONOMIC COOPERATION

Association of Canadian Community Colleges / Association des collèges communautaires du Canada

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Exemplary

TRAINING MODELS IN INDUSTRIAL TECHNOLOGY

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Jane Sweeney and Morag Tierney kept track of all the program details, a monumental task, and Students of Humber College's Journalism Program, under the direction of James Cullin, provided copy editing and final layout. Peter Perko of Humber's Marketing department was responsible for the design of all promotional materials, including the cover of this book.

The degree to which this research effort has been successful in identifying and describing innovative, resourceful, and noteworthy examples of training models in industrial technology in a pleasing and informative manner is a product of the efforts of many people. Errors and omissions are, of course, the responsibility of the principal researcher and project director.

Michael J. Hatton
Project Director

Toronto, Canada

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PREFACE

APEC-HURDIT

Established in 1989, the Asia Pacific Economic Cooperation (APEC) Forum is a policy-oriented organization that discusses economic and trade issues of interest to its members. APEC's objectives include: sustaining the economic growth of the region; enhancing gains resulting from increasing economic interdependence; developing and strengthening an open multilateral trading system; and reducing the barriers to trade in goods, services and investment among participants.

APEC membership includes Australia, Brunei, Canada, Chile, Chinese Taipei, Hong Kong, Indonesia, Japan, Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, the People's Republic of China, the Philippines, Singapore, Thailand and the United States of America.

Senior officials form the apex of the APEC structure. Reporting to this group are ten Working Groups, representing such areas as Transportation, Fisheries, Energy, Telecommunications, Trade & Investment, and Investment and Technology Transfer. One of the Working Groups, the Human Resource Development Working Group, has as its major objective, "responsibility for identifying the education and training needs of the Asia-Pacific region and to investigate ways of increasing the quality, efficiency and equity of education and training in the region ...." In order to achieve this objective, the Human Resource Development Working Group has spawned three Network Level groups to develop and implement activities in support of the broad human resource development goal. One of these network level groups is the "Human Resource Development for Industrial Technology Network" (HURDIT).

In terms of APEC objectives, training in industrial technology supports the development of a skilled workforce. In turn, the presence of a skilled workforce promotes industrial and economic development while enhancing the ability for industry to compete in local, regional and global markets.

Exemplary Models Project

Canada, as part of its commitment to the HURDIT Network, implemented a research activity to develop this book – an inventory of exemplary industrial technology training models. Canada's partners in this project were Chinese Taipei and Thailand, represented by the Employment and Vocational Training Administration (EVTA), and the Asian Institute of Technology (AIT).

In order to carry out this project, survey forms and general information outlining the nature of the Exemplary Models Project were sent to APEC-HURDIT member contacts in late 1994. In addition, certain training institutions were targeted for receipt of surveys based on national or regional reputations for excellence in a particular field of industrial technology. For the purposes of this project, Industrial Technology Training was defined as any instructional training program associated with or in support of extraction, processing or manufacturing processes. This

included, but was not restricted to, metal casting, extrusion, heat treating, injection, moulding, paper making, steel making, electronics, computers, automation, robotics, flexible manufacturing systems (FMS), computer-aided design/manufacturing (CAD-CAM), laser technology and the like.

The response rate to the surveys varied considerably by member. (Not all members participate in every APEC activity.) However, the overall number of responses exceeded two hundred, with many institutions providing considerable detail in the form of calendars, brochures, testimonials, and, in some cases, videos supporting the exemplary nature of their programs. Submissions were evaluated by an international panel, and follow-up on selected programs was done, most often in-person, by a staff of associate research fellows. From the initial submissions, and following the development of draft program descriptions, a selection of slightly more than fifty industrial technology training programs was chosen for inclusion in this book. These represent industrial technology programming in twelve APEC member economies: Australia, Brunei, Canada, Chinese Taipei, Hong Kong, Malaysia, New Zealand, the Philippines, the People's Republic of China, Singapore, Thailand, and the United States of America.

Notable Features

During the course of this research project, there were a number of recurring practices or themes exhibited by exemplary programming. Some of these are specific to training within industrial technology, while others are typical of exceptional educational practices more broadly.

A commitment to hands-on training using the same tools that trainees will use in industry is one of the most pervasive characteristics of the programs described in this book. Exemplified by the Precision Engineering Institute (Singapore), the Plastics Industry Training Centre (Hong Kong), and the Institut Kejuruteraan Teknologi Tenaga Nasional (Malaysia), this dedication to ensuring that the trainees "learn by doing" stands apart from all characteristics in terms of its commonality. Closely related is the provision of instruction by those who are continuing to work in the industry, either full-time or part-time. This is equally true in high-tech areas, such as the semiconductor training delivered by the Tze-Chiang Foundation (Chinese Taipei), as it is in trades and non-trades training, such as the training delivered by instructors from the shop floor at the Ford Motor Company (Australia).

In a similar vein, many exemplary programs work hard at imitating industrial conditions during the training process. For example, the Industrial Centre at the Hong Kong Polytechnic University prides itself on the "model factory" in which students are placed. This taste of the "real industrial world" helps ensure that the students are prepared for and readily adjust to work following program completion. At the Nanyang Polytechnic (Singapore), the organizational structure is geared to industrial standards, and students and faculty are required to be present for 44 hours per week. At the Southern Vocational Training Centre (Chinese Taipei), trainees in the Mechanical Turning Program attend eight hours per day for five and a half days per week.

Often, exemplary programming demonstrates a concern for minimizing the time spent training. This is reflected in a number of practices, including the use of competency-based training in order to ensure that the learner receives only the training that is required and is able to progress at a rate determined solely by the time taken to master performance objectives. Kemcor (Australia), for example, ensures that the duration of its Chemical Operator training is based only on the ability of each employee to develop specified competencies.

Similarly, there is a tendency to eliminate extraneous training in order to simplify programming and make the best use of training time. Maktab Teknik Sultan Saiful Rijal (Brunei), in its Aircraft Engineering Program, accomplishes this by focusing only on training for the specific type of aircraft equipment with which its graduates will be expected to work. Humber College (Canada), in cooperation with its partners, MARA (Malaysia) and Penn State University at Harrisburg (U.S.A.), has developed a continuous training program whereby engineering students can graduate with a three-year technical diploma and a four-year Bachelor of Engineering Technology degree following three years of uninterrupted, integrated college/university study.

By training or re-training workers while they continue working at their regular jobs, time is not lost and updated skills can be immediately applied on the job. The National Taipei Institute of Technology (Chinese Taipei) offers a collaborative program with Teco Electric and Machinery that illustrates this approach, as does King Mongkut's Institute of Technology North Bangkok (Thailand) in its cooperative program with the Federation of Thai Industry. Other examples include the National Kaohsiung Institute of Technology (Chinese Taipei) in cooperation with China American Petrochemical, and Black Hawk College (U.S.A.) in collaboration with Deere Harvester.

The involvement of private sector organizations directly in the training process, at the request of colleges and technical institutes, is another recurring theme. The Southern Alberta Institute of Technology (Canada), for example, relies on private sector partners to assist with the delivery of training in Thailand and Mexico. The Dualtech Training Centre Foundation (Philippines) is known for incorporating the school and the company in its "dual" approach to education, and the Meralco Foundation Institute (Philippines) requires industrial technician students to spend more than 1,300 hours training in-plant during the three-year program.

There is a trend for some large private sector organizations to handle their own training needs, independent of colleges, universities or technical institutes. Examples include Petronas' Institut Latihan Perindustrian Petroleum (Malaysia), and BeiNei Group Corporation, the largest manufacturer of engines in the People's Republic of China.

Also common is on-site training, underscoring the theme of bringing training to the workers, not the other way around. Collége Edouard-Montpetit's (Canada) training for Bell Helicopter Textron took place at Bell's facilities, even though the trainees were not Bell employees, at least not until after graduation. Stanwell Skills Development (Australia) is another example of training based on this approach.

Nationally accredited and transportable training is a hallmark of industrial technology training in Australia, as is recognition for prior learning. The Rural Water Corporation's (Australia) training in water resources management and TexSkill's (Australia) training in spinning operations typify these qualities.

The use of state-of-the-art equipment for the delivery of programming is increasingly routine. Once talked about more than practised, many institutions are building their reputations on high-tech delivery capability. Widely different examples include the Torrens Valley Institute (Australia), the Open Learning Agency (Canada), and the Auckland Institute of Technology (New Zealand).

Regional training is increasingly common, and particularly effective. Resources are shared, and students gain access to international staff. The Asian Institute of Technology (Thailand), the Delaware County Community College (U.S.A.), and the Colombo Staff Plan College (Philippines) make use of this approach.

Applied projects or capstone courses are another feature that is typical of exceptional programming. By way of example, Ngee Ann Polytechnic's Centre for Computer Studies (Singapore) requires students to complete a ten-week final project at the conclusion of its two-year program. And at Kirkwood Community College (U.S.A.), students in the Robotics, Automation and Process Control Program complete a capstone course that requires them to integrate all their learning in order to design and build a fully automated system.

Other noteworthy and outstanding features of the programming described in this book include articulation to support lifelong learning (see the Centre for Temperate Agri-Food Training, Australia, and its "enrolment surety" guarantee), demonstrated concern for the environment reflected in the approach to programming (see Temasek Polytechnic, Singapore, and its final year project), and the involvement of multiple and competing private sector partners (see Mount Hood Community College, U.S.A., and its Chrysler/Mazda training package).

Follow-up International Conference

A small sample of models from this book will be presented for examination and discussion at a conference in May 1995 at Toronto, Canada. This conference will focus on exploring in detail the features of exemplary programming within the field of industrial technology. The conference has been designed to attract training, engineering, manufacturing, technology, and human resource development experts from all APEC members.

Conference presenters have been confirmed from Australia, Brunei, Canada, Chinese Taipei, Hong Kong, Malaysia, the Philippines, Singapore, Thailand and the United States of America. All training institutions represented in this book are encouraged to participate in the conference.

ACRONYMS

ACCC Association of Canadian Community Colleges

AFMEU Automotive, Food Metals and Engineering Union (Australia)

AGV Automated Guided Vehicles

AIT Asian Institute of Technology (Thailand)

AIT Auckland Institute of Technology (New Zealand)

AMES Adult Migrant Education Service (Australia)

ALEXIS Automatic Layout Expert with Interactive Support System (Singapore)

APDC Asian and Pacific Development Centre

APENPLAN Asian and Pacific Energy-Environment Planning Network

ASE Automotive Service Excellence (USA)

ASF Australian Standards Framework

AS/RS Automated Storage/Retrieval System

ATC Advanced Training Centre (Philippines)

ATC Applied Technology Centre (USA)

BEE/M Bachelor of Electrical/Mechanical Engineering

BEW Beijing Engine Works

BIEM Beijing Institute of Economic Management

CAD Computer-Aided Design

CAI Computer-Aided Instruction

CAM Computer-Aided Manufacturing

CAP Chrysler Apprenticeship Program (USA)

CFTC Commonwealth Fund for Technical Co-operation (Philippines)

CIDA Canadian International Development Agency (Canada)

CIDA Construction Industry Development Agency (Australia)

CIM Computer Integrated Manufacturing

CIT College of Industrial Technology (Philippines)

CITEP Commonwealth Industrial Training and Experience Program (Philippines)

CMM Coordinate Measuring Machine

CNC Computer Numerical Control

CPSC Colombo Plan Staff College for Technician Education (Philippines

CRC Centre for Research Communications (Philippines)

CTAFT The Centre for Temperate Agri-Food Training (Australia)

DCCC Delaware County Community College (USA)

DOVE Department of Vocational Education (Thailand)

DPIF State Department of Primary Industry and Fisheries (Australia)

DTCC Delaware Technical and Community College (USA)

EDA Electronic Design Automation (Hong Kong)

EDTTC Electronic Design Technology Training Centre (Hong Kong)

EFC Evaporative Foam Casting

ESCAP United Nations' Economic and Social Commission for Asia and the Pacific

ESL English as a Second Language

FAA Federal Aviation Authority (USA)

FAC Flexible Assembly Cell (Singapore)

FEPADE Fundacion Empresarial para el Desarrollo Educativo (San Salvador)

FMC Flexible Machining Cell

FMHSS Flexible Material Handling and Storage System (Singapore)

FMM The Federation of Malaysian Manufacturers

FMS Flexible Manufacturing Systems

FTP Fellowships and Training Program (Philippines)

GMC General Management Program in China

GSI German-Singapore Institute

HKIE Hong Kong Institution of Engineers

HKPC Hong Kong Productivity Council

HRDC Human Resources Development Council (Malaysia)

HSS Hanns Seidel Stiftung (Germany)

IAM International Association of Machinists (USA)

IC Industrial Centre (Hong Kong)

IC-HKPU Industrial Centre of the Hong Kong Polytechnic University

IKATAN Institut Kejuruteraan Teknologi Tenaga Nasional (Malaysia)

ILO International Labour Organization

ILO Industrial Liaison Officer (Philippines)

ILPP Institut Latihan Perindustrian Petroleum (Malaysia)

ILSAS Sultan Ahmad Shah Training Institute (Malaysia)

IOP Industrial Orientation Program (Philippines)

IPCT Industrial Process Control Technology (USA)

IPG Industrial Project Group (Singapore)

IRTC Integrated Research and Training Centre (Philippines)

ITE Institute of Technical Education (Singapore)

ITP Industrial Technician Program (Philippines)

ITT Information Technology Institute (Singapore)

JCS Job Certificate Sheet (Australia)

JICA Japanese International Cooperation Agency

LCA Low Cost Automation (Malaysia)

MARA Majlis Amanah Rakyat (Malaysia)

MAS Malaysian Airlines Systems

MEPCO Matsushita Electric Philippines Corporation

MFI Meralco Foundation Inc. (Philippines)

MHCC Mt. Hood Community College (USA)

MRP Manufacturing Resources Planning

MTSSR Maktab Teknik Sultan Saiful Rijal (Brunei)

MTU Mobile Training Unit (USA)

NAITB National Automotive Industry Training Board (Australia)

NALLCU National Automotive Language and Literacy Co-ordination Unit (Australia)

NEAP Novell Education Academic Partner (USA)

NGO Non-Government Organization (USA)

NIA National Institute of Aeronautics (Canada) .

NIFTI Northern Interior Forest Training Initiative (Canada)

NKIT National Kaohsiung Institute of Technology (Taipei)

NMYC National Manpower and Youth Council (Philipines)

NPPI National Pingtung Polytechnic Institute (Taipei)

NT Northern Telecom (Canada)

NTC National Training Certificate (Singapore)

NVTC National Vocational Training Council (Malaysia)

OJT On-the-Job Training

OLA Open Learning Agency (Canada)

OMSD Office of Manpower Skills Development (Philippines)

PEI Precision Engineering Institute (Singapore)

PIC Private Industry Council (USA)

PLC Programmable Logic Controllers

PMTSB Petronas Management Training Sdn Bhd (Malaysia)

PRC Peoples Republic of China

RBA Royal Brunei Airlines

RBAF Royal Brunei Air Force

RIT Rajamangala Institute of Technology (Thailand)

RPL Recognition of Prior Learning

SAIT Southern Alberta Institute of Technology (Canada)

SDF Skills Development Fund (Singapore)

SPM Sijil Pelajaran Malaysia

SSDP Stanwell Skills Development Programme (Australia)

STC Specialized Training Centre (Philippines)

TAC/ABET Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (USA)

TAFE Technical and Further Education (Australia)

TASC Tasmanian Agricultural Services Consortium

TCFDA Textiles, Clothing and Footwear Development Authority (Australia)

TCFUA Textile Clothing and Footwear Union of Australia

TCTI Transport Canada Training Institute

TIAR Tasmanian Institute of Agricultural Research

TNB Tenaga Nasional Berhad (Malaysia)

TQM Total Quality Management

TRIP Teacher Release to Industry Program (Australia)

TUP Technological University of the Philippines

TVE Technical and Vocational Education (Philippines)

TWU Transport Workers Union (Malaysia)

UNDP United Nations Development Program (Malaysia)

UNI University of Northern Iowa

VAITB Victorian Automotive Industry Training Board (Australia)

VIC Vehicle Industry Certificate (Australia)

WADP Worker Attitude Development Program (Philippines)

WISE Worker Improvement through Secondary Education (Singapore)

WIT Workers Institute of Technology (Malaysia)

Automotive Industry Training (Non-Trades)
Vehicle Industry Certificate

offered by

Ford Motor Company of Australia
1735 Sydney Road
Campbellfield, Victoria 3061
Australia

THE PROGRAM

The Vehicle Industry Certificate (V.I.C.) Program is a major plank in Ford Australia's overall industrial training and development strategy. Briefly, this strategy has four major goals: (1) the development of a structured and accredited training program for the unionized workforce that links career progression to the attainment of skills and knowledge; (2) the delivery of a training program that enables multi-skilling and the development of a broader knowledge base for employees; (3) the creation of a learning environment that supports continuous improvement; and (4) the furnishing of opportunities for employees to attain higher education qualifications.

• *the certificate is nationally accredited and transferable*

The V.I.C. is nationally accredited and transportable. It was developed by the Automotive Industry in partnership with the union as a practical response to recommendations contained in a tripartite (Government, Industry and Unions) study report which investigated the "best practices" and international competitiveness.

The program is linked to a three tier career structure that provides pay increases for employees at each level in the structure. Employees must achieve a combination of skills and knowledge accreditation at each level in order to access these pay increases.

• *employees are paid for the skills and knowledge they bring to the job*

Prior to the introduction of the V.I.C., jobs were classified according to task and employees were paid accordingly. This made for a very inflexible workforce. Employees are now paid for the skills and knowledge they bring to the job, regardless of the job. The structure also acts as an incentive for employees to continually improve their knowledge and skills.

THE DELIVERY

There are two major components to the V.I.C., skills and knowledge. The skills training component of the V.I.C. is job specific. Delivery is on-the-job via job rotation, and every job has a job certificate sheet (JCS) which describes the competencies required under eight categories. Employees must demonstrate mastery of all competencies under each category in order for the job to be accredited towards the V.I.C.

The eight skills categories include: (1) do the job and reach production goals without assistance; (2) demonstrate knowledge of materials, parts and tools required for the job; (3) achieve specified quality standards; (4) maintain housekeeping stan-

dards; (5) perform routine maintenance as required; (6) conform to specified health and safety standards; (7) minimize waste; (8) communicate problems to the appropriate personnel.

Each JCS has a unit value which varies according to the complexity of the competencies associated with the job. The training time required to demonstrate competency varies with the complexity. Employees must complete twenty skill units in order to achieve their V.I.C.

The knowledge component of the V.I.C. is classroom based. It is delivered after working hours, on the employees' own time. One unit of the knowledge component is based on ten hours of classroom training. Employees must successfully complete twenty knowledge units in order to achieve their V.I.C.

Fourteen of the knowledge units are core to the curriculum and encompass generic knowledge. Included are subjects such as Occupational Health and Safety, Manufacturing Processes, Quality Improvement, Quality Measurement, Continuous Improvement, and Problem Solving. Subjects relating to Communication Skills and Working in Groups are also included in the core.

In addition to the fourteen core units required of all trainees, six elective units must be completed. Elective units are available in such diverse areas as iron foundry, aluminium casting, engine assembly and machining, stamping operations, automotive plastics, warehousing, paint operations, body construction and vehicle assembly.

SPECIALIZED RESOURCES

There are dedicated training facilities at all Company locations to support this program. The learning activities emphasize experiential methods, and trainees are expected to learn by doing. Units incorporate group work, discussion, role play, simulation games, workplace assignments, and video.

UNIQUE ELEMENTS AND BENEFITS

• *delivered by instructors who come from the shop floor*

The entire program is delivered and administered by training instructors who come from the shop floor – a peer delivery approach. Much of the program's success is attributable to this strategy as employees regard the training as credible and relevant to their needs.

The classroom based knowledge training is delivered outside of normal working hours under a training agreement negotiated with the Automotive Food Metals Engineering Union (AFMEU). Employees are paid at their normal hourly rate for half the time spent in knowledge classes.

Approximately 50% of Ford's total non-trades workforce is non-English speaking. In order to ensure that these employees can access the training and career structure associated with the V.I.C., the Company formed a consortium with three local colleges of Technical and Further Education (TAFE), the Automotive, Food, Metals

and Engineering Union (AFMEU), and the Adult Migrant Education Service (AMES). The result has been the creation of an integrated language and literacy program where employees develop and practice their language and literacy skills at the same time they acquire V.I.C. knowledge units.

Recently, numeracy classes have been introduced to assist employees with numeracy skills and provide easier access to the quality/measurement related units in the V.I.C.

In order to recognize the knowledge and skills of long serving employees the Company developed a Recognition of Prior Learning (RPL) model. This model takes into account the years of experience and type of job performed by the employee in order to determine the RPL credits allocated.

As indicated, the V.I.C. is a nationally accredited qualification through TAFE. This has provided employees who, for the most part, have not progressed beyond the middle secondary levels in formal education with the opportunity to achieve an accredited qualification. Furthermore, the V.I.C. provides the first stage in a career path leading to Trade, Foundation Studies, Associate Diploma, Degree and Masters Degree courses which are delivered on site in partnership with TAFE and Universities.

• *degree courses are delivered on site*

The portable nature of the qualification has meant that employees are able to apply for other jobs within the industry and have their qualification recognized.

DURATION OF TRAINING

The V.I.C. is a 400 hour program comprised of 200 hours of knowledge (classroom based) training and 200 hours of skills (on-the-job) training.

PARTICIPANTS

The V.I.C. is a voluntary program available to all non-trades hourly employees in the Company. All participants are employed on a full-time basis, and they move in and out of the job rotation in order to complete the skills component of the V.I.C. Typically about 30% of the participants are in rotation at any one time.

There are no educational prerequisites required for entry into the V.I.C.. The formal educational background of the participants in the program varies widely; however, most have not progressed beyond the middle of secondary level.

ROLE OF PARTNERS

This program involves many partners working with the Company on all elements of the program. For example, the Automotive, Food, Metals Engineering Union participated directly in the development of industry competency standards, provided industry Training Board representation, promoted and helped develop the English in the Workplace classes, supported on-going resolution of workplace issues related to the V.I.C., participated in the establishment of the joint Company/Union V.I.C. Steering Committee, and has been heavily involved in curriculum projects.

TAFE, through the Batman Automotive College, Broadmeadows and the Gordon, has participated in core curriculum development, elective curriculum development, trainer development, English in the Workplace classes, staff secondment/placement at Ford, technical advice, administrative assistance, and graduation ceremonies.

The Adult Migrant Education Service provided English in the workplace classes, an on-site language and literacy coordinator, specialist curriculum advice, trainer development, numeracy classes to support V.I.C. units, and shop steward training programs.

Similarly, the National Automotive Language and Literacy Co-ordination Unit (NALLCU) assisted with on-site language and literacy coordinators, curriculum development, language and literacy assessment and trainer development.

Another partner, the Ministry of Education – Victoria, through its Teacher Release to Industry Program (TRIP), provided a forty week industry placement of teachers from the Ministry of Education. This resulted in assistance with curriculum development and delivery, trainer development, programming/administration, and competency assessment.

Finally, the Victorian Automotive Industry Training Board (VAITB) and the National Automotive Industry Training Board (NAITB) established and supported forums for relevant policy discussions.

TESTIMONIALS

Terry Moran, Chief Executive Officer of the Australian National Training Authority, has spoken very positively about this program.

> *The Vehicle Industry Certificate is an outstanding example of what can be achieved when industry's needs are married with the educational and training needs of individuals. This nationally recognized course, which features Integrated Language and Literacy Training, has met industry's need for skilled workers and at the same time enabled thousands of Australia's production workers, many from non-English speaking backgrounds, to obtain formal qualifications for the very first time. The parties involved in the development and delivery of the Vehicle Industry Certificate are to be commended.*

Bill Mansfield, Assistant Secretary of the Australian Council of Trade Unions, has described the support for the V.I.C. from a trade unionists' perspective.

> *Trade Unions have supported the introduction of the Vehicle Industry Certificate which was awarded national accreditation in December, 1990. Through its broadly based training program to ASF 2 level, it incorporated key competency outcomes in areas such as quality, communications, teamwork, manufacturing processes and leadership. The V.I.C. has provided the opportunity for thousands of workers to firstly obtain a nationally recognized qualification relevant to industry and secondly to acquire the knowl-*

edge and skills to have a long term career in vehicle manufacturing rather than a job with limited prospects. The certificate is an example to other industry employers of how to build a better future.

Finally, Mike Howell, Senior V.I.C. Trainer, has described the impact on the shop floor.

... the true value of the V.I.C. is at the shop floor operator level. We are now able to take a single skilled operator and introduce them to new and, in many cases, different skills, and given support and encouragement, they are able to carry out duties required. They are also able to formulate and implement ideas that will enhance their operations.

- *the certificate is an example to other industry employers of how to build a better future*

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Evaporative Foam Casting
Operative to Semi-Professional Levels

offered by

Illawarra Institute of Technology
Foleys Road, North Wollongong
New South Wales 2500
Australia

THE PROGRAM

The principles and concepts of evaporative foam casting (EFC) have been known for some time; however, it is only recently that EFC has been generally accepted for use throughout the foundry industry. In part, this has been due to some unfortunate experiences of firms that initially tried to implement lost foam casting on a commercial basis. Barriers to firms introducing lost foam casting technology, both internationally and within Australia, have mainly related to a lack of understanding of the steps in the process, as there is relatively little technical information available, and traditional commercial secrecy continues to surround the process.

The purpose of the EFC Program at the Illawarra Institute of Technology is twofold: (1) to teach Evaporative Foam Casting and develop a detailed understanding of what products can be commercially produced by this process; and (2) to develop a network of EFC users and encourage the network to share their experience and technical knowledge with other users and potential users, both within and outside the network, leading to confidence and an increased rate of adoption for this technology. It should be noted that EFC has environmental and technical advantages compared to many existing foundry practices.

• *EFC has environmetal and technical advantages*

THE DELIVERY

The EFC teaching program is modularized and competency-based. As a result, it has been integrated into existing operator, trade and technician programs from areas such as foundry, metallurgy, mechanical engineering, production engineering, engineering design and drawing, toolmaking, and specialized machining. The modules can also be presented as stand-alone, one-week blocks, one day per week for several weeks, or consolidated into a firm's overall training and development programs.

Delivery techniques emphasize using EFC technology to produce commercial products and are based on integrating theory lectures with tutorials, practical demonstrations and structured project assignments.

SPECIALIZED RESOURCES

Resources include integrated CAD/CAM facilities for designing product prototypes and machine pattern dies. Foam pattern-making machinery is used to expand the foam beads, inject foam between the die faces, and produce foam patterns. As well,

an Evaporative Foam Moulding Casting Unit is used to pack the foam patterns in dry unbonded sand. Then, a vacuum is applied to hold the sand rigid. When molten metal is poured, the foam evaporates, leaving a sound casting in its place. The sand is recycled from the casting unit, and the casting is given a light clean prior to industrial use.

UNIQUE ELEMENTS AND BENEFITS

Castings are central to most manufactured products. EFC technology has the capacity to revive the Australian foundry industry, and generate new products creating both import replacement and export opportunities.

• *EFC technology has the capacity to revive the Australian foundry industry*

Integrating the teaching with commercial product development leads to increased adoption of the EFC process.

The cooperative network builds on the resources of the Institute by supplying research and application expertise. Unlike the application of EFC internationally, the Institute, in cooperation with its partners, is actively working to share and distribute information that is generally treated by others as proprietary knowledge. The underlying belief is that the entire group of foundry/manufacturing industries will benefit from the increased expertise that will come from broad adoption of this technology.

This program reflects a change in traditional thinking with regard to the role of an educational institution. In line with the "figure ground reversal" technique, central to quality improvement programs, the Institute has determined what services foundry customers and industry wish to receive, rather than simply considering what courses it wishes to deliver. The industry support focus is a unique element of the program which the Institute intends to use as a model in other programs areas.

• *the Institute has determined what services customers wish to receive, rather than simply considering what courses it wishes to deliver*

DURATION OF TRAINING

There are eight, 20 – 40 hour modules in the program. The first is an introductory module which covers the entire process. Each of the other seven covers a specific step. Included are Choosing a Product for EFC, Designing EFC Castings, Machining of Dies, Foam Bead Preparation, Foam Pattern Production, EFC Moulding, and Quality Control and Testing of EFC Castings.

PARTICIPANTS

Modules can be delivered to groups of twelve to fifteen participants. The level of participants varies from technical operators with minimal formal education through to postgraduate engineering and applied science researchers.

ROLE OF PARTNERS

The partnership model has been developed so that the objectives of each member of the network are complementary. Partners include Norton Villiers Aust. Pty. Ltd., (a company with a production foundry using EFC technology), UNIDRIVE (an automotive parts distributor, keen to gain access to parts not readily available within

Australia), the Department of Industry, Science and Technology (seeking to support the development of an export generating/import replacement industry), and the University of Wollongong (as a source of research projects for postgraduate students).

The network increases R & D efficiency, provides economies of scale and minimizes capital constraints by gaining access to staff and resources from a wide variety of sources. If the partners pursued this project separately each would need to internalize all the costs associated with developing the expertise required for each step.

TESTIMONIALS

This program has attracted considerable interest from the Government of Australia, as evidenced by comments from Senator Chris Schacht, Australian Minister for Science and Small Business.

> *An essential role is played by agencies such as the Illawarra Institute of Technology in supporting the uptake of new production technologies by local industry. In the case of Evaporative Foam Casting, I hope that the Government's support for the project via a grant of $A. 980,000 from the Industry Innovation Program will continue to benefit your work.*

Mr. Ron Warland, General Secretary of the Australian Foundry Institute (N.S.W. Division), noted,

• *it is refreshing to meet with those who are determined to be at the cutting edge of technology*

> *After almost forty years of association with the foundry industry, it is refreshing to meet with those who are determined to be at the cutting edge of technology, rather than lagging behind it.*

Chris Fletcher, Executive Director of Norton-Villiers Aust. Pty. Ltd., while addressing a seminar in 1993 on Evaporative Foam Casting, commented that the project's objectives are,

> *To develop EFC technology in Australia, diffuse it throughout industry, and to commercialize it to economic advantage. The three key elements, R & D, Education and Training, and Commercialization are best achieved from an economic rationalist or marketing point of view, by cooperation between the Illawarra Institute of Technology and Norton-Villiers, which enables available resources to be applied in the most cost effective manner.*

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Chemical Plant Skills
Operator Certificate Training

offered by

KEMCOR (Australia) Pty. Ltd.
228 Normanby Rd.
South Melbourne, 3002
Australia

THE PROGRAM

KEMCOR (Australia), with 810 employees, is the largest primary centre for production of plastics, rubber and petrochemicals in Australia. The company is a major employer in the petrochemical industry and has a commitment to employee education and training in the workplace. KEMCOR believes that its strength and competitive position are closely linked to the quality and skills of the employees within the Company.

Enhancement of employee skills can be achieved by: (1) identifying the skills (generic and job specific) for each job position and making this information available to all employees; (2) ensuring that training is an essential part of every employee's career development process; (3) holding performance assessment and counselling discussions that focus on skill enhancements for improved performance and developing a contract between supervisor and subordinate for the provision of appropriate training; (4) providing a training plan and program appropriate both to KEMCOR's business needs and to the personal growth and development of the employees; (5) ensuring that performance appraisals for supervisors include an assessment of their effectiveness in developing their subordinates through training.

KEMCOR has undergone workforce restructuring and the implementation of a skill based Enterprise Agreement. This Agreement required the development of written competencies for every position in the company. In turn, the competencies have formed the basis for the development of training modules that lead to an accredited program – the Operator Certificate in Chemical Plant Skills.

• *written competencies exist for every position in the company*

KEMCOR is a government sanctioned Private Provider. As a result, the training program includes the following attributes: (1) a recognized certificate (Operator Certificate in Chemical Plant Skills); (2) skill portability through recognition of accredited training; (3) accredited training delivered on the job; (4) recognition for prior learning; and (5) a competency-based training process.

The training program is broken into two elements, technical and generic skill competencies. All training has clear learning outcomes, performance criteria, and assessment techniques.

Technical skill training is geared towards the development of the necessary competencies for an operator to move from one job classification level to another. Each

technical skill area is supported by a structured training module, specific training materials and trainer support, and is delivered on the job and through classroom activity.

Current operators are provided with advance standing through a process known as Recognition of Prior Learning (RPL). A detailed skills matrix has been developed for RPL, and operators are assessed against this matrix by RPL consultants who are KEMCOR employees.

Generic Skills Training is predominately in two major areas: Teamwork, and Occupation Health and Safety. However, restructuring to create multiskilled, self-directed work groups at KEMCOR has led to the development of additional, structured training in the areas of Teamwork, Interpersonal Skills and Communication.

In the area of Occupation Health and Safety, structured courses are provided in Atmospheric Monitoring, Safety in the Workplace, and Chemicals and Chemical Safety.

KEMCOR has developed basic literacy training for operators. This is offered in cases where a skills gap has been identified between an employee's literacy level and the level required to enable vocational skill development and progression through job classifications.

THE DELIVERY

Training is delivered using a variety of methods, including: on-the-job using trained instructors; structured training days for technical updates and new plant developments held once every five weeks for each work team; theory training delivered in a classroom setting by qualified instructors at KEMCOR training facilities; and off-site training at an accredited training institution.

SPECIALIZED RESOURCES

• resources include fully developed training modules consisting of detailed learning outcomes, performance criteria and detailed assessment methods

Training resources at KEMCOR include fully developed training modules consisting of detailed learning outcomes, performance criteria and detailed assessment methods. Also included for each training module are training materials. These are typically print-based and, where appropriate, self-paced. Also available are computerized simulation programs, procedure manuals, process flow diagrams, and on-site equipment.

Five learning modules have been developed in-house. This number is expected to grow quite rapidly in 1995, and resources have been allocated to support this growth.

Computer-aided learning is used in areas where the fastest return on investment can be expected. This includes Work Permit System, Health & Safety, and the Environment. Trainees have responded very positively to the computer-aided approach to learning.

Cost constraints make the purchase of external resources difficult. However, part-

nerships have been developed with other companies to share the costs of the development of computer-aided learning packages generic to the Petrochemical & Oil Industries. This has included the Boiler Attendant Certificate and the Turbine Driver's Certificate.

UNIQUE ELEMENTS AND BENEFITS

The training program at KEMCOR is based on the principles of work-based learning, and a human resource strategy designed to achieve greater efficiency, skill formation, careerpathing and competitive advantage linked to National and State Training developments.

The training at KEMCOR involves the development of customized and highly structured training linked to a National qualification, a learner centred system with trained guidance and support, flexible delivery, a competency-based approach that weds the needs of the organization with direct benefits to the employees, and recognition of prior learning.

In general, the training program supports the National Training Reform Agenda, and ensures a close association between the National Chemical and Oil Industry Training Council, the State Office of Training and Further Education (TAFE) and the Victoria Allied Industry Training Board.

DURATION OF TRAINING

The duration and length of training is dependent on the employee's ability to develop the identified competencies to a specified standard. Nominal hours are noted for each module but employees may achieve the competency in less or more time than that specified. In general, attainment of competency in a technical skill area will take four to eight months.

• length of training is dependent on the employee's ability to develop the identified competencies

PARTICIPANTS

Approximately 250 operators take part in this program. The average operator is approximately forty years of age and has formal education to the grade ten level. Almost all operators are male.

ROLE OF PARTNERS

Industry training committees that have participated in the development of this program include the National Chemical and Oil Industry Training Board, the Victorian Allied Industry Training Board and the Australian Vocational Certificate (Chemicals) Pilot steering Committee. These groups have provided a strong industry needs focus, and have shared their expertise gained through years of developing a variety of training programs.

Australia's Office of Training and Further Education has provided funding support, as well as advice on the training reform agenda and the accreditation process. The Victorian Allied Industry Training Board contributed support and advice related to flexible delivery, the training reform agenda and coordination with statewide training developments.

TESTIMONIALS

• *a leading edge company in the provision of both vocational education and training*

F. J. Morrow, Executive Director of the Victorian Allied Industries Training Board has described Kemcor (Australia) as "a leading edge company in the provision of both vocational education and training in higher education."

• *the training program has the total support of the National Union of Workers*

Peter Kelly, President of the National Union of Workers, has praised the program on behalf of the workers represented by the union.

> *The Chemical Plant Skills Operator Certificate Training offered by Kemcor (Australia) Pty. Ltd. has the total support of the National Union of Workers. The NUW has more than 100 members (operators) at Kemcor and is delighted that these people will now have access to accredited training of the highest quality.*

Peter Harmsworth, Director of the Office of Training and Further Education for the State of Victoria, describes Kemcor's status as a registered private provider.

> *[The] registration provides evidence that Kemcor is a provider of quality training. In particular, .. it provides training which is accredited; has the human and physical resources necessary to provide accredited outcomes; observes ethical practice in relation to training participants.*
>
> *Additionally ... Kemcor is the only registered private provider of this course in this State. Further, the quality of the training offered has been recognized broadly across the industry. This is evidenced by the fact that in addition to providing training to its own employees, Kemcor now provides training to employees of other companies.*

Finally, W. McDonald, National Executive Officer of Chemical and Oil Learning (Australia), which is the national vocational education and training advisory council for the chemical and oil industry in Australia, describes the key role played by Kemcor in the development of vocational education within the industry.

> *The central role played by Kemcor Australia in the development of the National Chemical Operator Certificate and the flexible delivery materials associated with it must be acknowledged. This pioneering work is now proving of key use to plants in all sectors of the Australian chemicals and oil industry.*

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Food Production and Processing

offered by **The Centre for Temperate Agri-Food Training (CTAFT)**
North-West Institute of TAFE
P.O. Box 1234
Burnie, Tasmania 7320
Australia

THE PROGRAM

The Centre for Temperate Agri-Food Training (CTAFT) at the North-West Institute of TAFE (Technical and Further Education) is an elite national training school which includes the Open Learning Centre for food technology and the School of Engineering for food technology. Initial support for the development of the Centre matured as local industry, TAFE, the University of Tasmania, and the Tasmanian Government Department of Primary Industry and Fisheries (DPIF) recognized the benefits resulting from greater economic viability in domestic and international markets.

Early in the development of the Centre, it was recognized that processes for identifying and setting competencies within the food processing industry needed to be established based on national standards. The need for implementing "best practice", raising quality standards, and having better educated managers and employees in an increasingly technologically intensive industry became obvious. Training was the answer, and subsequently the North-West Institute of TAFE has been working with industry on a cooperative basis to identify and respond to these needs. Examples of industry partners working with TAFE in this area include Edgell-Birds Eye (vegetable processors), Lactos (cheese), United Milk Products, McCains (vegetable processors), King Island Dairies, Cadbury (chocolate), Inghams (poultry processors), Brambles (food transportation), and Tasmanian breweries.

• *high quality, flexible food production and processing education*

CTAFT provides high quality, flexible food production and processing education including an Associate Diploma of Applied Science (Agriculture), Rural Skills Traineeship, Farming Trade, Certificate of Food Technology, Advanced Certificate of Food Technology, Food Processing Traineeship, and customized training for individual industry needs. Training is based in the Institute complex which includes a 170 hectare, $1.97M (Aus.), TAFE/University farm operating as a commercial vegetable and livestock operation.

The program includes articulation arrangements with the University of Tasmania towards a Bachelor of Applied Science Degree (Agricultural Science), which in turn leads to graduate studies and the potential for doctoral and post-doctoral studies.

THE DELIVERY

The program includes flexible delivery methods as well as conventional face-to-face classroom based training. This provides for alternative delivery methods in order to meet individual client requirements. Examples include TAFE trainers conducting training on-site in industry, incorporating practice and theory with individuals and teams; remote facilitation by TAFE trainers with on-site learners responsible for formulating workplace training manuals specific to their applications; and interactive computer-based learning packages.

The training is characterized by multiple entry points into the hierarchy of training, recognition of prior learning, and articulation from the senior secondary sector and to the higher education sector at the University of Tasmania. The flexible delivery model extends across state borders and has the potential to be promoted through food processing companies such as Pacific Dunlop as a national initiative.

SPECIALIZED RESOURCES

The program is delivered through the collaborative use of facilities made available from food processing firms, the farming industry, and DPIF, as well as training in the Institute and University Centres. Resources include some of the largest and most modern food processing factories in the southern hemisphere as well as the DPIF research facilities.

Specific examples of resources include: modern food processing equipment (vegetable, dairying, honey, breweries, confectionary, poultry and meat) that enable students to see first-hand new technologies in food preservation, including laboratory techniques for quality assurance and grading technology encompassing optical technology; on-site training rooms equipped with teaching aids at food processing plants; vegetable packing plants; farms for on-site practical work; a tissue culture laboratory; dairy and vegetable research units for examining post-harvest problems in the processing industry; storage for frozen, refrigerated and cool store products; and transportation and shipping enterprises.

UNIQUE ELEMENTS AND BENEFITS

This program assists directly and forcefully in the development of Tasmania's potential for food processing. In addition, the program is unique in that it reaches and benefits rural people isolated from further education. The program also utilizes community resources and creates a 'critical mass' in technology transfer and research and development in a small state.

Program goals are achieved by linking the activities of the farming, food processing and training communities. The number and variety of partners in this program speaks to its uniqueness.

• *'enrolment surety', guarantees TAFE students a university place*

An aspect of the articulation process, called 'enrolment surety', guarantees TAFE students a university place during the second year of their Associate Diploma if they fulfill prescribed performance criteria.

The partners benefit through the group's ability to share information and focus on efficiencies that reduce costs and improve the quality of agricultural products from the raw material providers through to and including the supply of finished goods to both the domestic and export markets.

DURATION OF TRAINING

Courses range from short in-service training through to two-year full-time Associate Diploma study. The Certificate Programs typically require one year of full-time study, whereas the Apprenticeship Program requires three years. The duration of customized programs varies according to the type of training requested.

PARTICIPANTS

Students are drawn from all regions of Tasmania. Negotiations with national companies for training in food processing are underway, and international training opportunities have been identified and strategies developed.

The total number of students exceeds 1,000. Approximately 270 students are enrolled in part-time short courses, 420 part-time and 60 full-time students are enrolled in Certificate Programs, 200 part-time students are enrolled in the Advanced Certificate, and 30 full-time students are registered for the Associate Diploma. A total of 150 Apprentices also study in the program.

Approximately 60% of the students are male. Forty percent of the students have completed year 12 of senior secondary school.

ROLE OF PARTNERS

These programs are delivered with the assistance of the Tasmanian Agricultural Services Consortium (TASC). TASC includes the TAFE/University Joint Venture commercial farm, the staff and resources of the Tasmanian Institute of Agricultural Research (TIAR), the University of Tasmania's North-West Centre with its labs and research capability, the facilities of the DPIF including the Elliot Dairy Research Station and the Forthside Vegetable Research Station, and the facilities of the TAFE/Industry joint venture Flexible Learning Centre. In addition, Edgell-Birdseye and United Milk (Tasmania) provide on-the-job training facilities.

Together, these partners are able to deliver training, research and technology transfer.

TESTIMONIALS

Mr. Jim French, General Manager of Edgell-Birds Eye Vegetable Division, has nation-wide responsibility for one of Australia's largest food processing companies. He is a strong supporter of industry/TAFE links.

> *Edgell-Birds Eye is committed to the improvement of our work force at all levels, a commitment demonstrated by the enormous effort already expend-*

ed on the introduction of Best Practice to our organization and other industry specific training we have developed internally and in cooperation with TAFE.

• *everyone talks about achieving World Class Competitive companies, but the doing and the achieving needs real commitment and resources*

Everyone talks about achieving World Class Competitive companies, but the doing and the achieving needs real commitment and resources. The involvement of TAFE and industry in common objectives and well designed and resourced projects such as this, is the answer.

Mr. Glen Graham, Manager of the Devonport Branch of Edgell-Birds Eye, has worked closely with TAFE in developing flexible delivery courses.

I see training as a vital element for improving our competitiveness both in the domestic and import market. In conjunction with best practice models, bench marking, and quality assurance programs, training is the key to making it possible for us to move forward.

By bringing training programs on site, work schedules are affected less, training is work related, and the employer together with the employee has greater involvement in the development of the training.

The model which is being developed by TAFE is also valuable in the way in which it has achieved strong collaboration between various training bodies, industry, government, and unions.

Professor Robert Clark, Head of Department for Agricultural Science at the University of Tasmania has been closely involved in the development of collaborative systems between TAFE and the University. In particular, he was involved in the purchase of jointly owned facilities, the organization of jointly taught classes, and the implementation of joint enrolment systems between the University and TAFE. Professor Clark feels that,

The flexibility that has been gained through many of these joint initiatives between educational bodies has helped students from a variety of backgrounds to access training programs. It has also enhanced the quality of training and the ability of educators to respond to the needs and interests of relevant industries.

The Tasmanian Rural Industry Training Board has worked closely with the North-West Institute of TAFE in the development of the Centre for Temperate Agri-Food Training. Mr. Zichy Woinarski, the Executive Officer, says,

... the work undertaken by the Centre is at the forefront of agricultural education and training. The Centre has responded to industry's needs and has been innovative in meeting the demands and skills of vocational education and training; so much so that the developments in Tasmania, highlighted by this Centre, have become "the best practice" for the rest of Australia for rural education and training.

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Water Distribution and Construction

Water Resources Management Program

offered by

Rural Water Corporation
Training Services
P.O. Box 165
Tatura, Victoria 3616
Australia

THE PROGRAM

The Water Resources Management competency-based program provides a three-level, on-the-job (OJT), integrated training program for water distribution and construction and maintenance employees. The three levels include a Certificate in Water Resources Management, an Advanced Certificate in Water Resources Management, and an Associate Diploma of Applied Science (Water Resources Management).

In striving for more commercial, customer focused work practices, the Rural Water Corporation identified a need for improved competency training of its large number of field-based staff. There were no existing accredited courses, offered by educational institutions, that were oriented to water industry operation. Therefore, with Government support, the Rural Water Corporation developed the Water Resources Management Program and obtained the required status to enable the organization to award accredited certification.

• *assessment methodologies and standards relate directly to workplace requirements*

The learning outcomes for each module in the program are performance oriented and the assessment methodologies and standards relate directly to workplace requirements. The program is conducted, for the most part, on-site and is based on self-paced modules. Supervisors act as mentors, providing support to trainees and guiding them through the program. Concurrent work experience is required to enrol in this program.

• *supervisors act as mentors, providing support to trainees*

The overall structure of the three levels supports the progressive development of skills and knowledge. Learning across the three levels is linked so that each level provides the prerequisites for and leads directly into the subsequent level. Each level, or exit point, is based on a plateau of vocational outcomes associated with the work of a particular occupational group.

The Certificate level program provides the skills and knowledge to work in a specific vocational area across a range of related activities performed with a minimum of direction and supervision. This program encompasses Levels 2 and 3 of the Australian Standards Framework (ASF). Certificate modules include "Storage Water Regulations", "Confined Space Entry", "Channel Regulations and Operations", and "Construction Methods".

The Advanced Certificate program provides skills and knowledge to prepare participants for work in first-level supervisory/administrative positions. It builds on the Certificate program by developing skills in problem solving, resource management, quality control, management of small groups and communication to a standard appropriate to the workplace situation. Entry to the program is normally via the Certificate; however, for those seeking direct entry, Recognition of Prior Learning (RPL) is available to match the skills and knowledge of individual participants against the performance standards of the program. The Advanced Certificate requires application of skills across levels 4 and 5 of the ASF. Examples of Advanced Certificate modules include "Earthworks", "Storage Flood Routing", "System Performance Analysis", and "Planning and Scheduling Deliveries".

The Associate Diploma enables graduates to work at a para-professional level, and focuses on managerial and strategic skills.

THE DELIVERY

Delivering credentialed training to its workforce, which is disadvantaged by considerable geographic distance from metropolitan centres, has been the major challenge facing the rural water industry. On-the-job, self-paced instruction has offered the solution.

Learning outcomes, assessed by trained supervisors, cover the key skill competencies of each module. Where further work is required for participants to gain the skills, workbooks facilitate the self-paced instruction, acting as a guide for both trainee and supervisor. Trainees are required to complete each exercise in consultation with the supervisor as directed in the module. This aproach facilitates the development of a team-based approach to supervision, with the supervisor acting as a coach and leader.

The predominant delivery mode of structured on-the-job experience is supported by more formal methods including workshops and short courses, as well as specific workplace learning programs, such as literacy support, when and where needs warrant.

• flexibility in the delivery approaches has been critical to the program's success

This variety of approaches ensures that the program caters to individual variations in learning styles. The workforce profile is that of a group which has learned for the most part by "doing", and few have been recently engaged in formal education. Flexibility in the delivery approaches has been critical to the program's success.

SPECIALIZED RESOURCES

• participants in the training program use the same equipment that is used in daily work activities

Participants in the training program use the same equipment that is used in daily work activities carried out at the corporation. In this way, practical applications are, by the very nature of the resources, embedded in the program.

For some modules, competency in the use of specialized equipment is required. For example, "Confined Space Entry" requires the use of a specialized safety harness

and breathing apparatus. For the weed spraying module, the use of spraying equipment and related safety clothing is critical. The equipment modules focus on the use of small, hand-held equipment such as chain saws through to the operation of large excavators and other earth-moving equipment.

UNIQUE ELEMENTS AND BENEFITS

Unique elements of the program include the course delivery methods, the assessment procedures, RPL, and the skills management data base.

Formative assessment of learning outcomes is generally carried out by the person conducting the training, usually the supervisor. The purpose of this assessment is to ensure that the learner is progressively developing the skills and knowledge required to achieve the objectives of the module.

Summative assessment at the conclusion of a module (i.e., of all the learning outcomes associated with that module) is based on activities which combine the learning outcomes into a meaningful assessment task. This enables evaluation of the aggregate workrole so that contingency management, task management and job-related environment factors can be assessed in combination with the specific technical aspects of the role. These assessments are conducted by a three-person panel comprised of a subject expert, a person who is independent of the assessment process, and a supervisor/trainer.

The Corporation's RPL process acknowledges employees' skills and knowledge obtained through formal training (industry and education), work experience and/or life experience. District Coordinators are trained to implement the RPL process as part of their role in coordinating the program. RPL candidates are provided with proformas which require them to reflect upon their areas of expertise in relation to the learning outcomes. The follow-up discussion to confirm the areas of required training is conducted by an RPL panel.

• *the database allows employees to check their progression at all times and eliminates the need for paper-based verification procedures*

Access and efficiency are the hallmarks of the skills management database developed by the Corporation. This database allows employees to check their progression at all times and eliminates the need for paper-based verification procedures. All course information and the details regarding each employee's attainment of learning outcomes are held and updated on a data base which is available to all districts. Reports can be generated by individuals directly from the database. Manipulation of information, however, is restricted to District Coordinators. In addition, the Program Manager generates a Skills Passport each quarter. This results in a printed progress update for each participant.

As well as providing a record of achievement for participants, the database provides vital information to District Coordinators for the planning and monitoring of training to support operational requirements at district and regional levels. In addition, these reports provide quality checks on the implementation of the program.

DURATION OF TRAINING

The program duration for the Certificate is approximately 400 hours. For the Advanced Certificate, program duration is approximately 600 hours, and the diploma program requires, an additional 600 hours.

Training under the Water Resources Management Program is self-paced. Participants are not required to meet pre-conceived time restraints, and there are no formal entry requirements although it must be remembered that the program requires concurrent work experience.

• *participants are not required to meet pre-conceived time restraints*

PARTICIPANTS

There are approximately 400 participants enrolled in the program.

As mentioned previously, the program is designed for employees with traditionally low levels of education. From a survey conducted in July 1993, it was determined that slightly more than 70% of the participants had completed grade ten, eleven or twelve. The remainder had not completed formal education beyond grade nine.

The average age of this workforce is forty-two years and the average length of service with the organization is twelve years.

ROLE OF PARTNERS

The program has an Advisory Committee comprised of participants, management and independent members from other Water Authorities. The Advisory Committee is responsible for total program monitoring and ensuring new techniques and up-to-date methods of operation are included in the course.

TESTIMONIALS

When the program began in 1992, Mr. J. Nathan, Executive Director of the Vocational Training Bureau, offered the Corporation his "congratulations on attaining private provider status in what is, without doubt, one of the most important training initiatives in many years."

Later, at the formal launch of the Water Resources Management Program, Mr. T. Moran, former General Manager of the Department of Employment and Training, noted that, "the Commission is to be particularly commended because the courses and [the private provider] registration represent not only a willingness to develop structured and credentialed training, but to confront and address difficult and emerging issues in what is flexible and responsive industry based training."

Also at the launch of the Program, Mr. J. Davidson, State Director of the Federal Department of Employment, Education and Training, stated that "a very encouraging feature of the development of this project has been the spirit of co-operation and enthusiasm for the project that has existed throughout the various components of the Rural Water Commission and the water industry."

The Australian Services Union described "this initiative of the Rural Water Commission [as] an example of what unions and employers can achieve by working together". And Mr. N. Campbell, former Victorian Branch Secretary of ASU, said,

• *an example of what unions and employers can achieve by working together*

> *I'm sure none of the [ASU members involved in the project] knew what active participation was going to mean in terms of workload but having canvassed their view they all said it was an interesting and enlightening experience. ... I congratulate the Rural Water Commission on persevering through this exercise...*

Some of the most important testimonials come from the participants of the program. The following comments were received as part of a survey of participants.

> *... given the opportunity for the skills I possess to be recognized has given me a sense of personal achievement and self worth.*
>
> *... at first I had doubts of its usefulness but after completing five or six modules, I have a wider understanding of RWC operations.*
>
> *... given me confidence in what I do.*
>
> *... been beneficial in enhancing my skill level and I feel has gone a long way in generating a 'team approach'.*
>
> *... brought training to me that I would normally not get because the classroom terrifies me so I shy away from the situation.*

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Skills Development - Building and Construction Industry

offered by

Stanwell Skills Development Programme
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Rockhampton Mail Centre
Queensland, 4702
Australia

THE PROGRAM

The Stanwell Skills Development Program (SSDP) was established to train a construction workforce for the development of the Stanwell Power Station site in Queensland. The objective was to train local people for this project, rather than rely on migrant specialists from other areas of Australia. The program currently trains workers for the Stanwell site and for work in other building and construction projects.

• the objective was to train local people, rather than rely on migrant specialists

Specific examples of training modules and courses include: welding, steel fixing, steam systems, explosive powered tools, rigging, quality concepts, plan interpretation, and construction site management.

The program incorporates the relevant components of the National Training Reform Agenda. These include a competency-based training approach; modularized and self-paced learning materials; modules/programs accredited and linked to nationally recognized standards; literacy in the workplace; occupational, health and safety components; and an underlying philosophy of workplace reform through a consultative process.

THE DELIVERY

Students receive training via several delivery modes. These include lecture, facilitated group discussion, one-on-one student mentoring and, most importantly, on-the-job (OJT) instruction. The OJT emphasis ensures that the theoretical component is complemented very directly with the practical skill components.

•OJT ensures the theoretical component is complemented with the practical skill components

The accent is on self-paced learning, where students are encouraged to manage their education.

SPECIALIZED RESOURCES

The training programs are based on self-paced learning manuals. These manuals incorporate simple language with no jargon, thereby allowing students with limited reading ability to participate in the programs. Also, the text in the manuals is interspersed liberally with graphics. This provides variation and further supports partici-

pants with weak reading skills. Activity questions enable participants to test themselves as they complete the material, and students can exit at the end of any unit.

The modules and learning materials were developed by skilled workers who were trained as instructors and mentors. The fact that the course developers are themselves skilled in the field of study enhances the practical nature of the materials. The learning materials are the most important element in this program.

• *the learning materials are the most important element in this program*

Specialized equipment and materials also includes videos that have been produced for specific programs (eg: Steam Pressure Equipment, Stress Relieving, and the Use of Overhead Cranes and Scaffolding Materials).

UNIQUE ELEMENTS AND BENEFITS

Through this grass roots training program, SSDP maximized the involvement of local labour in the construction of the power station with 72% of the workforce coming from Central Queensland. This involvement of local people has led to a better understanding and acceptance of the project and its attendant benefits to the community and economy. Many unemployed people have gained new or enhanced skills through participation in the training programs, and they can use those skills in many industries. The result is greater flexibility and mobility.

SSDP is recognized by the Construction Industry Development Agency (CIDA) as a model project for workplace reform. The benefits derived by this program include an improved skills base at the local level, an integrated safety and education program with demonstrable results, stronger, local communications and commitment to the job, and a payroll that is disbursed within the local economy.

Follow-up studies have described a host of benefits, including: a massive reduction in injury and sick time when this project is compared with other construction activities of this magnitude; a fatality free project (currently) that is on-time and on-budget; a very low rate of time lost to industrial disputes (approximately 1%); and the enhancement of skills for more than 600 workers leading to improved efficiency and productivity.

• *this program brought training to the people*

Rather than bringing the people to the training, this program brought training to the people.

DURATION OF TRAINING

The duration of the training programs vary. Some are single modules, while others contain a group of modules. Generally the programs are delivered in forty hour modules which can be divided into smaller units for ease of delivery and assessment. Given the competency-based nature of the program, the forty hour figure is an imprecise indicator. Many students can complete a unit in a shorter time frame, while others take slightly longer to achieve the necessary competencies.

The self-paced nature of this training program means it can be delivered in approxi-

mately one-third of the time typically required by a traditional lock-step program. The costs savings, to students and employers, has been enormous.

• *the cost savings resulting from the self-paced nature have been enormous*

PARTICIPANTS

Since SSDP's inception in February 1990, more than 1,100 students have enrolled in the program. Most participants study on a part-time basis in the evenings.

The typical level of education achieved by the majority of participants prior to entering the program is grade 10 in the secondary system. It must be noted that SSDP programs range from entry level training through operative non-trade, technical and engineering streams. Qualifications for some of the higher level programs vary from Engineering Certificate Level 1 to an Advanced Certificate or Associate Diploma in engineering or construction.

ROLE OF PARTNERS

SSDP networks closely with TAFE, the University of Central Queensland, and private providers in the development and delivery of the training. All students who undertake SSDP programs are enrolled through TAFE and successful students receive TAFE certificates. This ensures program recognition and the portability of certification.

The University has provided training facilities and training programs to SSDP students on a reciprocal basis.

Local industry and businesses have benefited from SSDP's expertise in training and workplace change, and network partners have joined forces to provide articulation arrangements along vocational pathways that range from Engineering Production Certificates to Associate Diplomas.

TESTIMONIALS

The Stanwell Skills Development Program received Queensland's 'Employer of the Year' Award for its training program, and since that time accolades and imitations of its training programme have been plentiful.

Gai Sheridan, from the Australian Department of Employment, Education and Training, has described SSDP as pioneering and innovative.

> *... Stanwell is still foremost in pioneering new and effective training... . The programme was always innovative and as it has matured I know it has become a true exemplar of 'best practice'. I am also sure that you [SSDP] are now seeing tangible returns in productivity for your efforts and investment ... there have been several others looking to emulate your programme, and [I know] that Stanwell has earned an excellent reputation for true Queensland courtesy and hospitality, and preparedness to give your valuable time and support to those who come 'knocking at your door' for information and help.*

Dawson Petie, General Secretary of the Australian Council of Trade Unions, argues that the Stanwell program has been highly successful for all participants.

> *The Programme's success can be measured by the results achieved in the area of curriculum development and delivery. Course material developed by SSDP is being widely used on construction sites throughout Australia. The innovative training delivery system – on the job training – a skill centre on site - created an unprecedented demand for training from wide sections of the workforce, resulting in excess of 700 workers successfully completing TAFE accredited courses and the issuing of more than one thousand certificates. SSDP has been a rewarding experience for all concerned.*

Finally, Peter Barda, C.E.O. for the Construction Development Agency, thinks that SSDP is "providing a spark needed for the introduction of a work place culture change ...". He notes that,

> *when visiting the Stanwell Power Station Site, it is apparent that the enthusiasm and initiative of the SSDP has provided positive benefits to employees and employers alike. The construction industry in Australia is reaping the benefits of the curriculum development and the proof that training does make the difference.*

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Spinning Operations
Textile Industry

offered by

TexSkill Limited
25 Dawson Street
Brunswick, Victoria 3056
Australia

THE PROGRAM

TexSkill offers accredited and nationally recognized training for workers in the Spinning Industry. This includes a Certificate in Spinning Operations, an Advanced Certificate in Spinning Operations, as well as short courses for electrical/mechanical technicians who service spinning machines.

The Certificate Program provides workers with a formalized learning framework, and is divided into two stages. The course structure is designed to provide maximum flexibility with regard to delivery, and entry and exit points. Participants may elect to complete single modules only, or one stage only, or the full program. Assessment is competency-based, and Recognition of Prior Learning (RPL) principles are applied. Credit is given to participants who are able to demonstrate skill competencies for any module.

• *credit is given to participants who are able to demonstrate skill competencies for any module*

Participants must be employed at a spinning mill before they may begin the program.

The Advanced Certificate Program is similar to the Certificate Program in that there is flexibility with regard to entry and exit points, RPL applies, and all assessment is competency-based. Completion of the Advanced Certificate will result in credit towards further studies, including the Associate Diploma of Electronics and the Associate Diploma of Textile Technology. Modules for both the Certificate and the Advanced Certificate focus on Machine Operations, Quality Maintenance, Team Skills, and Factory Communications.

Short courses include a Certificate for Supervision, general textile courses, as well as courses for the operation and maintenance of Schlafhorst (Autoconer), Trutzschler (Blendomat), Volkman, and Zinser machinery. These courses are aimed at supervisors, operators, mechanics and electricians.

TexSkill is also involved in the Textile Industry Traineeship (Spinning) Program, funded by the state governments of Australia. The traineeship program is designed for youths aged 16 - 19, and provides them with an opportunity to begin developing the broad range of skills and qualifications necessary for a career in the textile industry. In the Traineeship Program, there is a close link between on-the-job and off-the-job training.

THE DELIVERY

Most of TexSkill's programs are factory based. These are tailored to meet the individual needs of each company, while ensuring viability for certification and recognition. This means that all elements and modules can be individualized to meet the industrial needs of specific employers, yet employees enjoy the benefits of training that is recognized at the national level.

TexSkill also operates a training centre with some of the best spinning equipment that modern technology has to offer, complete with spinning lines for cotton, worsted and woollen systems.

SPECIALIZED RESOURCES

The Skills Centre machinery is valued at more than $3M (AU). Included are a Trutzchler Cotton Line, a Schlafhorst Autocorod, a Schlafhorst Autoconer, a Zinser Draw Frame, a Volmann 2.1 Twister, a Repco Spinner, a Calvam Twister, a Schlumberger Gill Box, a Zinser Ring Spinning Frame, a Mackie Semi-worsted Spinner, a Houget Ring Spinner and a Tatham Woollen Card.

TexSkill has pioneered the production of high-quality spinning machine manuals, useable by operators with low literacy levels. To date, approximately 90 machine specific manuals have been produced by TexSkill for operators and advanced operators for 15 companies across Australia.

UNIQUE ELEMENTS AND BENEFITS

TexSkill's operator training programs have been a first for the spinning industry in Australia, and the experience gained in the development of this programming is now being emulated in other areas of the textile field.

TexSkill's practical on-the-job (OJT) training balances two requirements. The first is for the training to meet individualized needs of the company, in accordance with its expectations, machinery, procedures and facilities. The second requirement is for the training programs to provide an accredited career path. The result is a program that satisfies the client company and the trainees with customized training that is nationally recognized and therefore portable.

• *customized training that is nationally recognized and therefore portable*

TexSkill also offers assistance with the development of individualized training manuals. The value of operator training manuals, specific to a company's machinery, layout, procedures and policies, is invaluable. In one plant, a TexSkill consultant, working in consultation with a supervisor, mechanic and operator, might write the manuals. In another mill, the TexSkill consultant might be an advisor or editor only. The individualized or customized approach is at the heart of TexSkill's "meet the client's needs" philosophy.

TexSkill has become known for several key qualities, including: taking an active approach to the sourcing of funding opportunities that enable training materials to be developed and provide in-factory training release time for employees; providing integrated training that helps companies achieve production and quality improve-

ments while reinforcing measurement and accountability; developing a range of training materials and course content that offers learning opportunities at every level of language proficiency; offering courses in country mills and across all shifts (night shift employees have always been the forgotten people); customizing training and supporting companies to develop their own training programs so they become less dependent rather than more dependent on TexSkill; producing product knowledge courses and manuals for self-paced distance learning; meeting the demand for basic and advanced technician training by holding short courses at TexSkill's Skills Centre with overseas instructors supplied by European Manufacturers.

As a result of these initiatives, TexSkill's enrolments have increased from 67 in 1992 to more than 700 in 1994.

DURATION OF TRAINING

The length of the courses varies from a few hours to one year depending upon the requirements of the company. RPL affects the duration of courses.

PARTICIPANTS

Over 700 workers enrolled in TexSkill courses in 1994. Being fully employed, all participants study part-time in TexSkill programs.

The level of education and demographic profile of the training program participants is similar to the general profile of workers in the textile industry. For the most part this means low levels of education and literacy, and a high percentage of migrant and female workers.

ROLE OF PARTNERS

TexSkill is governed by a board comprised of representatives from industry, unions, government bodies and TAFE.

TexSkill's Skills Centre is located within the Melbourne College of Textiles. This provides access to their facilities, and the opportunity for cooperation on projects and exchange of ideas.

TESTIMONIALS

Mr. Peter Vinney, Senior Manager with the Textiles, Clothing and Footwear Development Authority (TCFDA), has described TexSkill's purpose and value.

> *[TexSkill] was designed to provide high quality training and up-to-date technology in order to develop a highly skilled, technically advanced and competent workforce for a world competitive industry. TCFDA through its extensive dealing with Australia's textiles industry, especially spinners, is acutely aware of the valuable role played by TexSkill as a leading and unique provider of skills training to industry. The role of TexSkill can only be expected to become more important as the textiles industry continually upgrades its capital to match world best practice.*

John van Dolderen, Joint National Secretary of the Textile Clothing & Footwear Union of Australia (TCFUA), praises TexSkill for its contribution in the move from a system of remuneration for the job performed to a system of remuneration for the skills brought to the job.

> *The TCFUA recognizes the vital contribution by TexSkill to the provision of a formalized career structure for workers in the spinning industry. Award restructuring for the textile industry came into effect in October 1992. The award now has a skill based classification structure, so employees are paid according to the task they perform. These skills are reflected in the new national competency standards. Until TexSkill gained accreditation for their Certificate and Advanced Certificate in Spinning Operations, there was no formalized training available to workers in this industry which matched the skill based award. Spinning industry employees now have a nationally recognized, competency-based training system which reflects the award restructuring, and articulates into related certificate and diploma courses. TexSkill is to be congratulated for developing their certificate courses which filled the void in available training for spinning operators.*

Gay Gallagher, Executive Officer of the Victorian Textile Clothing & Footwear Industry Training Board, praises TexSkill for it support.

> *In a short period, the TexSkill model of training, and its related training manuals, has gained widespread recognition. This is because TexSkill was able to understand and respond to the special needs of the spinning industry in terms of accessibility, flexibility and equity requirements.*

Finally, Mr. David Alexander, General Manager for Yarra Falls Pty Limited, describes the effect on the shop floor.

> *Our company is progressively moving to cellular production methods, and we required a training program which would facilitate this move and make each cell as effective and productive as possible. TexSkill has recently completed a period of training for workers in the first cell. I am pleased to report immediate and positive results in two areas: (1) a significant increase in productivity achieved earlier than expected; (2) a demonstrated improvement in team work.*

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Electronics Program & Information Technology

offered by

Torrens Valley Institute
of Vocational Education
100 Smart Road
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THE PROGRAM

In January 1992, Tea Tree Gully College opened its doors under the banner "A College for the 21st Century". Since then, the college has amalgamated and become Torrens Valley Institute of TAFE. Dedicated to the development of self-directed, life-long learners who are responsive to the changing needs of society, the College produces "enterprising graduates" in areas of identified skills shortage using efficient, cost effective strategies.

The Electronics and Information Technology Program at the Torrens Valley Institute of Vocational Education provides quality vocational preparation and skills development which meets the needs of students seeking to enter the electronics industry. In particular, the program seeks to address shortcomings in the availability of electronics education to non-urban students by offering programming with a unique blend of characteristics that includes: off campus, self-paced study; continuous intake and exit; computer-based training and computer-based course management; recognition of prior learning; recognition and documentation of enterprise skills; and very strong links with industry.

The curriculum spans from entry level (Certificate Programming) through to specialist areas (Associate Diplomas).

THE DELIVERY

The Electronics Program, like all other programs offered at the Tea Tree Gully Campus of the Torrens Valley Institute, is student-centred in its approach. Delivery characteristics include: continuous entry or open-entry/open-exit; competency-based curriculum; students decide what they learn, when they learn, how they learn and where they learn; the development of industry competencies; the fostering of broad-based generic skills; and weekly intakes.

• *students decide what they learn, when they learn, how they learn and where they learn*

It is possible for students to study up to seventy modules at any one time, and the overall learning environment is administered and tracked by a student management system (SMART) that was designed by the faculty.

SPECIALIZED RESOURCES

The Electronics Program relies heavily on student-centred, interactive learning guides and support learning materials. The bulk of these materials is currently print-

based; however, the development, customizing and integration of computer assisted learning modules has begun.

Off campus links via phone tutorials and modem connected computer system linkages have been established to support learners in rural regions. Additionally, video conferencing facilities are available in order to provide tutorial support for these same students.

• *modem connected computer system linkages have been established to support learners in rural regions*

On campus workstations include DEC equipment, PCs, CAD systems, microprocessor training and development systems (HC11,80805). Software packages include C, C++, MASM, Quick C, Protel CAD packages, P Spice, and others.

Resources are designed to provide students with hands-on rather than theoretical knowledge, and the program is supported by an intensive work placement program.

UNIQUE ELEMENTS AND BENEFITS

The Electronics and Information Technology Program prepares students for the "new look" workplace, an environment characterized by more highly skilled workers, multi-skilled workers, flat management structures, multi-disciplinary and self-managed teams, and workers who regularly upgrade their skills.

To prepare graduates for this "new look" workplace it is important that they not only have highly developed industry specific knowledge and skills but that they also possess a range of enterprise skills (generic skills/attributes). These include: the ability to communicate orally and in writing; the ability to work with other people of all types; the ability to make judgements; the ability to demonstrate effective time management skills; the ability to be innovative and self-starting; the ability to take initiative; the ability to problem solve; the ability to access and process information; and the ability to make decisions and accept responsibility for the consequences of those decisions.

Students who enrol in the Electronics and Information Technology Program book into general and specific teaching and learning sessions where multi-subject learning modules are facilitated by staff working in what can be best described as an R & D laboratory workshop. As many as sixty individuals grouped into small study support units are managed in this environment at one time.

DURATION OF TRAINING

Certificate programs, fully embedded and integrated into the comprehensive curriculum, can be completed in 12 months. The Associate Diploma in Computer Systems Engineering is nominally conducted over two academic years. However, given the Institute's flexible delivery approach, students may complete the courses (reach acceptable levels of competency) in much shorter periods of time. The total duration of the curriculum is 1,500 hours (nominal).

PARTICIPANTS

There are 280 students enrolled in the Certificate Program. Students in this program must have achieved grade eleven, and a math and sciences background is preferred. Approximately 60% of the students come directly from secondary schools, while the remaining 40% come from industry. The Advanced Certificate Program enrols 35 students each year, while the Associate Diploma enrols 122. Grade twelve is required for these programs, as is a maths and science background.

Thirty spaces are available for the off-campus Certificate Program, while a further 18 spaces are dedicated for special bridging students. Applications for these programs exceed available places by a 2:1 margin.

In addition to on-campus activity, students may access the program from strategic industries such as the Royal Australian Air Force (RAAF) Airbase, where employees independently and freely access the curriculum.

ROLE OF PARTNERS

The program has benefited from significant contributions from industry, including both technical input and equipment. Digital Equipment of Australia, for example, has provided equipment, technical expertise, technical documentation and knowledge transfer in support of this program, while the University of South Australia and the Regency Institute have worked jointly with the Institute on the preparation of learning materials for this program. In addition, various local electronics engineering enterprises have provided industry placement, joint R & D projects, assessment panels and program evaluation in support of this training.

Other companies that have supported the program include Veltec, Altera Technology Park, Adelaide Micro Electronics Centre, Quest Electronics, Force Electronics, Radio Rentals, CADSMAN, Texas Instruments, Telecom, Motorola Semiconductors, and Philips Semiconductors.

TESTIMONIALS

Since its official opening in 1992, the Tea Tree Gully campus has acquired an international reputation as an exemplar in the use of student-centred methodologies and innovative delivery systems. Evidence of this distinction has been reflected in accolades received. For example, in 1994, the Tea Tree Gully campus was selected by the Royal Institute of Public Administrators of Australia as the public sector example of "World's Best Practice", and in 1994 Tea Tree Gully was chosen as the site for the International Conference on Learning Environment Technology. This conference, which attracted some 1400 participants, was sponsored by UNESCO, OECD, the Multi Function Polis, the Department for Employment, Training and Further Education, the Royal Australian Institute of Architects and the Australian Professional Association for Institute Managers.

• *an international reputation as an exemplar in the use of student-centred methodologies and innovative delivery systems*

The New Zealand Qualifications Authority, Wellington, New Zealand chose Tea Tree Gully campus as the site for the production of a thirty minute training video on

"Quality Management Systems" and a number of senior managers from the Institute have been involved in consultancies, both in Australia and overseas, to assist other learning institutions in moving towards the use of flexible delivery systems.

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Aircraft Engineering

Aircraft Maintenance Technician Training

offered by **Maktab Teknik Sultan Saiful Rijal (MTSSR)**
Simpang 125, Jalan Muara
Negara Brunei Darussalam

THE PROGRAM

This training was first introduced in Brunei in 1984 to meet a growing demand by the Royal Brunei Air Force (RBAF) for trained technicians to maintain and service their fleet of military helicopters. In close co-operation with the military, Maktab Teknik Sultan Saiful Rijal (MTSSR) designed a program of studies that provides trained technicians with strong theoretical and practical knowledge, complemented with hands-on experience that has specific relevance to the requirements of Brunei.

Most aircraft technician programs are designed to produce technicians who will work on a wide range of aircraft types. By designing a narrowly focused, highly specialized program for the RBAF in Brunei, more training time is spent directly on training specific to a narrow range of aircraft types. Consequently, unnecessary training has been eliminated from the program, making it more efficient, more cost effective and easier for students.

• unnecessary training has been eliminated from the program, making it more efficient, more cost effective and easier for students

The program includes a general engineering first year, followed by two years of specialized work. The initial specialization was introduced to train Airframe Engine technicians, and a further specialization was introduced in 1992 to train Avionics technicans.

In 1988 a separate program was introduced to support Royal Brunei Airlines (RBA). This program delivers training for Boeing 757 and 767 Airframe and Engine Technicians. It is coordinated by a Training Advisory Committee consisting of members from MTSSR and the RBA Maintenance, Training and Administration staff.

All students in the aircraft technician programs are sponsored by employers, and all are virtually guaranteed employment on completion of the course.

THE DELIVERY

The program is designed for secondary school leavers and the training is conducted in three phases. The first phase focuses on general engineering and is taught at MTSSR. It includes mastering the use of machine and hand tools as well as measuring instruments. Also included are mathematics, science and English comprehension at levels appropriate for the requirements of the specialized aircraft engineering phase.

The second phase, Specialized Aircraft Engineering, is also taught at MTSSR,

where training models, demonstration panels, and aircraft components are used to illustrate aircraft engineering principles and servicing techniques.

The third phase is taught off-site. For one stream, the Aircraft Practical Phase is taught at the RBAF's training school which houses all helicopters currently operating in Brunei and used as non-operational training aircraft. The other stream is taught at the Royal Brunei Airlines site, where students assist in the servicing bays with maintenance tasks on operational Boeing 757 and 767 aircraft.

The aircraft engineering phase involves approximately fourteen modules. Student centred lessons build on the basic scientific principles taught in the General Engineering Phase, and practical assignments train students to research information. Classroom work in the form of experiments familiarizes the students with the application of scientific principles, and practical tasks train students in the use of tools, ground equipment and safe working practices.

• *unique student study guides have been developed*

Unique student study guides have been developed to include material relevant to the needs of Brunei, and practical tasks utilize aircraft maintenance manuals.

Assessment for all modules takes the form of subjective and objective testing, orals and practical assessments.

SPECIALIZED RESOURCES

Two training hangars are used to house the training equipment. One is located at MTSSR and the other at the airfield.

The MTSSR hangar is equipped with several training bays. One area houses two Cherokee fixed wing aircraft and one Jet Ranger helicopter. These are not complete aircraft, but they serve to provide initial hands-on experience. The hangar is furnished with compressed air supplies, and aircraft compatible electrical supplies (D.C. 28V and A.C. 115/200V 400 Hz) provide a ring supply to the laboratories for demonstrating aircraft component functions.

An instrument laboratory includes test equipment for demonstrating the operation and functional testing of most helicopter instruments. The sheet metalwork bay is fitted for airframe repairs, and fitting and turning exercises are completed in the Mechanical Workshop.

The airfield training hangar houses all the helicopter types operational in Brunei. These are functionally operational helicopters. This resource is used solely for the practical training of MTSSR students.

The Royal Brunei Airlines practical training is accomplished by attaching trainees to Royal Brunei Airlines for one day each week. The attatchment provides students with experience working on operational aircraft, where they act as helpers to the licensed aircraft engineers. The practical exposure is strong motivation and promotes many questions during the classroom instruction at MTSSR.

UNIQUE ELEMENTS AND BENEFITS

By combining the facilities at MTSSR with the operational facilities of the airfield, cost effective and efficient training is achieved, while potential difficulties that could be experienced in the transition from a training environment to an operational unit are eliminated.

In the past, training has focused on obtaining paper qualifications rather than meeting the operational requirements for maintaining aircraft. This program emphasizes the absolute essentials.

The close cooperation between the MTSSR, the Royal Brunei Air Force and Royal Brunei Airlines makes this program exceptional, and the involvement of the Training Advisory Committee ensures that all training requirements are met and continually updated to satisfy changes in technology.

• close cooperation between the MTSSR, the Royal Brunei Air Force and Royal Brunei Airlines makes this program exceptional

DURATION OF TRAINING

The General Engineering Phase is a full-time one-year course and is the required foundation for all aircraft specialty training.

Two aircraft specialty courses are conducted for the Royal Brunei Air Force: Airframe/Engine Technician and Avionics Technician. These are two-year full-time courses comprised of approximately 50% theory and 50% practical work.

A separate specialty course is conducted for Royal Brunei Airlines Airframe/Engine Mechanics/Technicians. This is a two-year full-time course, with a one day per week attachment to Royal Brunei Airlines.

PARTICIPANTS

Secondary school leavers who have completed two GCE 'O' levels (mathematics, science and English preferred) are eligible to apply to the program. An interview, including an English Comprehension Test and an Engineering Aptitude Test, is required.

The courses provide a steady turnover of mechanics/technicians, but care is taken to avoid saturating the workforce with inexperienced personnel. A large number of newly trained mechanics/technicians could dilute the experience and skills of the total workforce and create a potentially hazardous maintenance environment. Consequently, enrolment limits are enforced.

ROLE OF PARTNERS

The Royal Brunei Air Force and Royal Brunei Airlines strongly support the practical elements of the course. Their involvement is critical.

The effectiveness of the program is assessed by the practical aptitude of the mechanics and technicians working on the job. This is the true test of any training

program. Weaknesses are referred to the Training Advisory Committee, which then introduces modifications to the courses. The RBA Base maintenance Superintendent is a member of the committee. This ensures that the program has a direct link with the employer.

• *an external moderator ensures that the training methods and examinations are compatible with international standards*

Finally, an external moderator from an aircraft college in Australia visits Brunei periodically and ensures that the training methods and examinations are compatible with international standards.

TESTIMONIALS

The Royal Brunei Airlines Maintenance Manager has stated.

> *... MTSSR haseverything that is required to cover basic training and RBA can provide the top-up training to bring the students in line with [servicing] large transport aircraft. I also think that both MTSSR and RBA, working together, can produce a better Mechanic and Licensed Aircraft Engineer than we are at present getting from overseas.*

Martin Farrar, Project Aviation Training Manager for the Para Institute in South Australia, has assessed and described the program.

> *The training received at MTSSR will provide the necessary theory and basic practical for students to attain good levels of achievement in their fields of study and progress into chosen careers.*
>
> *The course has been well planned out. All procedures and progress reports have been well documented through the design of needed forms. The course schedule has been organized on visual charts showing modules, time frames and instructors to be used.*
>
> *I have viewed several exams for most subjects and they all appear to be relevant to the learning objectives of the course. Block examination reports are a good record of student progress and contain remarks on each student's abilities and problems.*

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PSIM Programmable Logic Controller Simulator

offered by

Durham College
Skills Training Centre
Whitby, Ontario
Canada

THE PROGRAM

In 1993 Durham College committed to develop a computer-based training program to address PLC Technology training, for both self-paced and instructor-led groups.

For this program a computer software package was developed by Durham College software developers to enable a personal computer (PC) to act as a process simulator when demonstrating or teaching PLC's. A built in Ladder/Logic editor allows students to create, test and debug industry standard ladder/logic programs which control the animated process. Typical industrial processes such as material transfer operations using a conveyer or batch mixing tanks complete with pumps and metering can be graphically displayed on the computer. The processes are displayed and fully animated. As well, they will respond to the ladder/logic of a PLC in the same manner that actual equipment responds. For example, a properly addressed output coil can be used to start a pump on a mixing tank. Once started, a visual indication of the pump's rotation and fluid flow will appear on the computer screen. Further, a digital signal representative of fluid flow would be transferred back as an input to the PLC program.

Upon successful completion of the PSIM program the students learn to program basic relay inputs, output instructions, counter timer circuits, compare functions and debugging procedures. An interactive tutorial training program has also been developed to provide an introduction to the PLC Technology, and this is used as a prerequisite to the program.

• *an interactive tutorial has been developed as a prerequisite to the program*

THE DELIVERY

The program is delivered in an electronics computer room equipped with twenty five PC's. This accommodates a student/teacher ratio of 25:1. The program is instructor-led, and the students work on industrial-based projects. The introductory program requires ordinary PC's for operation, and the advanced program requires a PC with a PSIM interface board.

SPECIALIZED RESOURCES

Durham College acquired the Cadbury building in Whitby to bring together in one location its skill trades training, including the PLC training facility. The building covers 180,000 sq. ft. of training space and is one of the largest in Canada. Built with a $20 million (Cdn.) grant, this world class training centre is the realization of

the college's vision and commitment to high quality training. It is also the result of collaborative ventures and partnerships between government, education, and industry.

This facility guarantees total quality and student success. It is equipped with an impressive array of machinery, tools and computers, much of which has been donated by area industry. The facility boasts modern and attractive student classrooms and labs, and has state- of-the-art computers in an open concept work area.

Committed to life-long learning, the industrial training centre offers personalized training to meet the needs of individuals and companies. Programs and courses range from automotive training to programmable logic controllers (PLC), and from pneumatics and hydraulics to electrical and mechanical trades.

UNIQUE ELEMENTS AND BENEFITS

• *one of the benefits has been the substantial time saving for developing the process simulation*

One of the main benefits of this program has been the substantial time saving for developing the process simulation. In the past, a process simulator had to be physically built, similar to the manufacturing process it represented, in order to enable the students to input the various operational sequences. The process simulation can now be created on the computer screen both to visualize the process and to identify the correct operational inputs and outputs.

An additional benefit is that students enjoy programming using interactive graphics. This offers both challenge and variation. Durham has developed a library of industrial processes which can be simulated on the computer screen.

DURATION OF TRAINING

Due to the diverse range of trainees, the program has been designed to be flexible in its delivery. The advanced training program is 40 hours in length and may be offered in block, day or extension formats. Training can be arranged to be held on site at the company. The length of time required for the introductory program is dependant on the background and experience of the students.

PARTICIPANTS

Trainees include industrial clients, post-secondary college students, apprentice electricians and pre-apprentice electricians.

ROLE OF PARTNERS

One of the major strengths of Durham College has been its relationship with business and industry and its ability to offer training programs where and when needed. This bond was very evident in the partnership between, industry, government and the college in the acquisition and subsequent renovation of the training facility.

A major supplier of electronic components has won the rights to distribute the PSIM software, both in the USA and Canada. This partnership was formed on the basis of

the strength of the product and the reputation of the college and the individual who developed the software. Currently, the software is being purchased by community colleges and industrial plants using PLC for the training of their personnel.

The PSIM program can be used for training related to most brand name PLC manufacturers.

TESTIMONIALS

Support for the PSIM program is very strong and comments reflect the comfort and ease of understanding of the subject material by the students.

Mr. Tom Cannon of Jet Composites Ajax, Ontario, has described student reactions to the training program.

> *The students loved the PSIM program, and they have talked me into buying the program for our company. Your product is excellent.*

Mr. Brook Collins of A.G. Simpson Oshawa, Ontario, echoed these thoughts.

> *The students thought the program was great. They really understand the concepts.*

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Aeronautics - Structural & Electrical Assembly

offered by

National Institute of Aeronautics (NIA)
College Edouard-Montpetit
5555, place de la Savane
St. Hubert, Québec
Canada J3Y 5K2

THE PROGRAM

Established in 1984, Bell Helicopter Textron, a division of Textron Canada Ltd., inaugurated its production facilities in 1986 in St. Janvier, a small town situated near Montreal's Mirabel International Airport. This particular area, in two decades, has become the centre of a fast growing Québec aeronautical sector. Involving more than 150 companies, 32,500 workers and sales totalling 4.5 billion dollars (Cdn.) in 1992. Québec's Aerospace industry is responsible for about half of all such business in Canada.

Since its inception, Bell Helicopter Textron has become Canada's leading manufacturer of helicopters. Some of its better known crafts are the Jet Ranger and Bell lines of commercial helicopters. By creating this division, the Texas-based parent company chose to transfer all activities related to commercial helicopter design, manufacturing and assembly to its Québec plant. In conjunction with this transfer, Bell Helicopter Textron was required not only to meet its delivery schedules, but also to maintain and improve the quality of its aircraft and the competitiveness of its production costs. In order to meet these objectives, Bell Helicopter Textron needed to increase its workforce by approximately 200 employees for each of the next six years in a field where the need for qualified personnel greatly exceeded the supply. Recruiting qualified workers from other companies in the aeronautical sector was rejected for its dubious ethics and the possibility that it might induce wage escalation.

• *the solution was to establish a custom-designed on-site training program*

The solution proposed by Québec's National Institute of Aeronautics (NIA), a subsidiary of Collège Edouard-Montpetit, the largest French community college in Canada, was to establish a custom-designed on-site training program. Analyzing its training needs, Bell Helicopter Textron identified two specific work categories that accounted for more than 60% of its workforce: structural assembly workers and electrical assembly workers. The first group is responsible for assembling the aircraft fuselage; the second for the production and installation of electrical mounts and flight instruments. In partnership with the National Institute of Aeronautics, Bell Helicopter decided the training program should be tailored to these two job categories.

THE DELIVERY

A customized training program, designed by the National Institute of Aeronautics, was created for structural assembly workers and electrical assembly workers.

Validated by Bell Helicopter, each of these programs is comprised of approximately 480 hours of theoretical instruction and technical training in the following areas: applied mathematics, sheet metal, manufacturing and assembly processes, assembling and riveting, electrical reliability, plating, setting, electric welding, work processes, and electrical layouts.

SPECIALIZED RESOURCES

On-site delivery of instruction and training required a unique approach and specialized resources, since the NIA is located on Montreal's South Shore, approximately 60 kilometres from Bell Helicopter's manufacturing facilities. A rather ingenious solution was found by NIA specialists: designing and leasing two prefabricated classrooms that were then installed on Bell's grounds. A local manufacturer of prefabricated housing units was involved in the production of these two mobile classrooms. This part of the project required NIA to produce plans and specifications for the actual construction, furnishing and tooling of the two 16 meters long by 5 meters wide instructional units. Additional plans and specifications were prepared by NIA for raw materials and student tool boxes. All tools and raw materials were identical to Bell Helicopter's own equipment and materials. In addition, full-size mock-ups of a helicopter's ceiling and nose piece and of six instrument panels were specifically designed and manufactured for this program. The Canadian Federal Government and the Québec Provincial Government provided funding for the design and procurement of the prefabricated classrooms and the training materials.

UNIQUE ELEMENTS AND BENEFITS

This program was designed at the outset to be a high quality integrated training system that included: selection, training, qualification, and hiring. It demanded on-site and real time coordination from various bodies of government and educational institutions. During the first three years of this program, 90% of the graduates were hired. For many of these individuals, it was their first opportunity to work in a well paid high technology industrial environment. Many of them had been unemployed prior to entering this program.

• *it was their first opportunity to work in a well paid high technology industrial environment*

A great deal was learned from this specific, custom-designed, on-site program by Federal and Provincial government bodies responsible for manpower and training at both administrative and policy levels. For the National Institute of Aeronautics, benefits ranged from updating instructors' practical industry experience to adding state-of-the-art equipment and training facilities to its existing educational resources.

And last, but not least, Bell Helicopter Textron obtained measurable sustained benefits from this training program. Qualified personnel increased twofold (from 683 employees to 1,250 employees), a goal many specialists described as impossible when preliminary studies were made. Further, the employee turnover rate dropped significantly, from 17.5% to less than 4%, resulting in a savings of $200,000 (Cdn.) in rehiring and retraining costs alone. Productivity increased almost threefold, from 74 aircraft per year to more than 200, and revenues almost quadrupled in the same period, going from $71M (Cdn.) to $270M (Cdn.).

DURATION OF TRAINING

The training program was fourteen weeks in duration, and encompassed approximately 490 total hours of instruction and shop floor work. Each training day included approximately three hours of instruction in the custom-designed classroom, followed by five hours of training on the shop floor. New student groups were recruited every three months for the duration of the project.

This training package started in March 1989 and continued until the end of 1991. Instruction was delivered by a team of more than a dozen teachers from the National Institute of Aeronautics in collaboration with trainers from Bell Helicopter's human resource department and various managers and supervisors. During the program's existence, 218 students were trained, 182 as structural assembly workers and 36 for electrical assembly jobs.

PARTICIPANTS

• *trainees were selected from among unemployed workers receiving unemployment benefits and persons holding part-time, low paying jobs*

Participants in this program were selected from among unemployed workers receiving unemployment benefits and persons holding part-time, low paying jobs. Most candidates were local residents and more than 90% of all hired employees live within a 20 kilometre radius of the plant. Although the available jobs were in a traditionally male dominated sector of industry, 15% of all recruited participants were women.

A most demanding selection process of the candidates was done in-house by Bell Helicopter and Canada Employment and Immigration specialists. Candidates were screened by means of a succession of tests, in-depth interviews, and theoretical and practical exams designed with the help of NIA's educators. Screening also included a complete medical exam. This process enabled the company to recruit candidates who had the greatest likelihood of completing the training program.

ROLE OF PARTNERS

Such a large and highly specialized training program could not have taken place successfully without teamwork. Funding in the order of $2M (Cdn.) was provided by the Canadian government through various manpower programs; Bell Helicopter contributed through human resources allocations and the provision of specialized equipment. Selection of candidates required the collaboration of the company's human resource department and training specialists from the National Institute of Aeronautics, plus two levels of government. Designing and implementing the training facilities required the expertise of the prefabricated housing unit manufacturer, NIA's educational technology experts, and a rather flexible approach to municipal bylaws by the local township's officers.

The National Institute of Aeronautics has delivered a similar customized program for Sanyo Canada, and is looking forward to offering more of this programming in the future.

TESTIMONIALS

Top management at Bell Helicopter Textron and the St. Janvier plant have been very satisfied with the quality of the workers trained and hired through this project. While management initially hoped to hire qualified workers at the onset of production, they have since realized that a longer, more complete local process has generated a highly productive, qualified and motivated group of workers, something direct hiring of qualified individuals may not have guaranteed. Increased productivity, reduced manpower costs, and lower personnel turnover are seen as significant long term benefits of this specific program.

• *local process has generated a highly productive, qualified and motivated group of workers*

Bell Helicopter's supervisory and management personnel were also quite pleased with the process since it permitted many of them to hone their training skills and share their expertise with the students.

Since the completion of this program, the Commission de la formation professionnelle, Québec's worker training agency, has regularly presented the Bell Helicopter/NIA training partnership as a formula that other employers should learn from and follow. Moreover, it awarded it's "Optima" prize to this project in March of 1991.

Charles Larocque, director of Human Resources at Bell Helicopter, has enthusiastically expressed his company's appreciation of strategic alliances, such as the on-site training program, in an article he wrote for the February 1993 issue of the trade magazine *Gestion*.

> *Since large scale engineering or human resource projects cannot be accomplished alone anymore, strategic alliances have become essential. Bell Helicopter has associated itself with economic partners from industry, labour, manpower training and education. The various links and collaborations Bell Helicopter has established with its partners from the public sector, and more recently with its suppliers and customers, are but a few examples of productive alliances.*

Yves Turcotte, a Preflight Teacher at NIA, had this to say about the training program.

> *The experience of teaching near the assembly lines permitted me to increase my knowledge of aircraft structures.*

And Jean Dussalt, a Mechanical Assembler at Bell Helicopter and NIA Program graduate, described the value of the program in personal terms.

> *Before the beginning of this training I didn't know anything about aeronautics or the assembly of helicopters. This training program helped me find a good job with good wages.*

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Engineering Technology

offered by **Humber College, Canada**
Majlis Amanah Rakyat (MARA), Malaysia
Penn State University at Harrisburg, USA

THE PROGRAM

• *a cooperative program designed, developed and implemented by Humber College, MARA, and Penn State University at Harrisburg*

This Engineering Technology Program is a cooperative program designed, developed and implemented by Humber College (Toronto, Canada), Majlis Amanah Rakyat - MARA (Kuala Lumpur, Malaysia), and Penn State University at Harrisburg (Pennsylvania, U.S.A.).

Humber College, one of the largest comprehensive community colleges in Canada, enrols more than 12,000 full time students and more than 80,000 part-time learners annually. Humber has a strong reputation in the field of industrial technology, offering more than 20 distinct technician and technologist diploma programs. MARA is an agency of Malaysia's Ministry of Public Enterprises charged with specific responsibility to facilitate the training and participation of native Malays for occupations in the fields of industrial technology and commerce. Penn State Harrisburg is a senior college, offering graduates from community and junior colleges, as well as transfer students from other colleges and universities, the opportunity to earn baccalaureate and graduate degrees. The Engineering Technology programs at Penn State Harrisburg are recognized as among the best in North America, and all are accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET).

In 1991, Humber was approached by MARA with an invitation to develop a comprehensive technical training program for native Malaysians in the fields of electronics, robotics, instrumentation, CNC, and CAD. The target group of trainees was high school graduates with a minimum of two years industrial work experience. MARA recruited, tested and upgraded students as necessary, initially enroling 71 of 650 applicants.

Humber identified four Canadian colleges (Humber, Durham, Centennial and Lambton) to provide the first phase of the training. Humber delivered the CAD and CNC training, Durham delivered the Electronics training, Centennial delivered the Robotics training, and Lambton delivered the instrumentation and control training. Each of these colleges has a particularly high profile in the designated engineering specialization. All are located in the Greater Toronto area, with the exception of Lambton which is approximately one hundred and fifty miles to the west.

In each case, the programs delivered by the four Ontario colleges are the same as the standard two-year, four semester engineering technician training programs offered by the colleges. In approximately 75% of the program courses, the Malaysian students are in classes with Canadian students. Following the two-year

technician program, more than 90% of the students have elected to complete the optional third year, which leads to technologist qualifications. Following this, approximately 60% of the students continue on and take an additional year of studies at Penn State, graduating with a Bachelor of Engineering Technology Degree.

At the conclusion of this program, the graduates return to Malaysia well-equipped to actively participate in one of the world's fastest growing economies.

DELIVERY

Engineering technician diploma programs at Ontario Colleges consist of four, sixteen-week semesters with an average course load of twenty-five hours per week. Technologist qualifications require two additional sixteen week semesters. In these programs, the first four semesters include approximately 50% theoretical and 50% practical training. In the fifth and sixth semesters, 70% is theory and 30% is practical.

• *students complete six semesters of study in a twenty-four month period.*

This program is offered in a continuous format. This allows the students to complete six semesters of study in a twenty-four month period. This is followed by one full year at Penn State Harrisburg in order to complete the requirements for a Bachelor of Engineering Technology. Students return home in three years with a three-year Engineering Technologist diploma and a four-year Bachelor of Engineering Technology degree.

• *students return home in three years with a three-year Engineering Technologist diploma and a four-year Bachelor of Engineering Technology degree*

SPECIALIZED RESOURCES

The equipment in Ontario Colleges is the same as that which is used by local industry. This creates realism in the training process, and prepares job-ready students.

Humber College's CNC and CAD programs rely on state-of-the-art CNC machines. Electronics workshops at Durham College house digital electronics and computer engineering test and analysis units that reflect emerging trends in these fields. The robotics workshop at Centennial College is equipped with PLCs, and hydraulic and pneumatic trainers which simulate a broad range of training scenarios. Lambton College has a state-of-the-art centre dedicated to process control technology, including PLCs and distributive control systems.

Laboratory facilities at Penn State Harrisburg include a CAD lab, an electrical lab, a mechanical lab, as well as chemistry, physics, and material testing laboratories.

UNIQUE ELEMENTS AND BENEFITS

The reduced time for completion of the technologist and baccalaureate qualifications is unique to this program. There are significant cost savings for MARA, and students are only away from home for three years.

Access to the university degree program directly after graduation from the technologist program is another unique feature. This opportunity has resulted from extensive curriculum mapping accompanied by minor program modifications. Also, the stu-

dent selection process is stringent; fewer than 15% of applicants have been accepted into the program.

The total educational experience combines the practical experience of a college education with the more theoretical education delivered by the university.

DURATION OF TRAINING

The Engineering Technologist Program is delivered over a two-year period. The follow-on program at Penn State University requires twelve additional months.

PARTICIPANTS

Students were selected by MARA from among applicants who had a pass in the Sijil Pelajaran Malaysia (SPM) with credits in Mathematics, Physics, Science and English. Additionally, those who have been accepted into the program are holders of a Vocational Training Certificate and each has a minimum of six months working experience.

ROLE OF PARTNERS

Humber College is the lead North American institution organizing and delivering the programming on behalf of MARA. Humber coordinates all aspects of the training program in Canada, and was responsible for establishing and developing the linkage with Penn State Harrisburg.

• *Humber College is the lead North American institution organizing and delivering the programming on behalf of MARA*

Regular meetings take place with the participating colleges, and MARA is provided with frequent updates on the program by Humber College. In addition, MARA has field staff based in Washington and Chicago who provide logistical support to the students during their time in North America.

TESTIMONIALS

Faculty members at the Canadian colleges are very positive about this program. Professor James Montgomery, Faculty Coordinator and Malaysian Student Counsellor at Humber College, has said,

> *The Malaysian students bring strong, demonstrated commitment to their learning. Each of them is a positive role model, for each other and for Canadian students.*

Barry Stedman-Smith, Director of International Programs at Durham College, is very impressed with the students.

> *These [Malaysian] students are among the best we have in the Canadian college system. They work very hard, attend class and participate without fail, and they demonstrate the curiosity necessary for success in the highly technical specializations.*

Mohd Sabri bin Haji Sidek is the group leader for the students at Humber College. He speaks very positively about the training program.

• *we learn from knowledgeable teachers and experience life in Canada*

> *We get to learn from very knowledgeable teachers in well equipped laboratories, and we have a chance to experience life in Canada ... including the snow and the winter. All the Malaysian students realize this is the opportunity of a lifetime and embrace it fully.*

Norm Rath, Vice President at Lambton College, is a strong supporter of the program.

> *At Lambton we are very impressed with the quality of the Malaysian students. They are highly motivated, and have excelled in their studies. They have adapted very well, and are regarded highly within the community.*

Dean Michael Harper noted in an address to a graduating class at Humber College, that "the majority of Malaysian students in Mechanical Engineering Technology have received honours standing. In addition, several have won awards and distinction in technical contests. We are proud to be associated with them."

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Sawmill Workers Upgrading - Millwrights & Electricians

Northern Interior Forest Training Initiative

offered by

Open Learning Agency (OLA)
Workplace Training Centre
1445 10th Avenue
Prince George, British Columbia
Canada V2L 2L2

THE PROGRAM

Sawmills in British Columbia are among the most technologically advanced in the world. However, low turnover among workers has resulted in sophisticated equipment being maintained by millwrights and technicians who received their training years or even decades ago. In 1992, representatives from the Open Learning Agency (OLA), the Forest Industry Union, the Federal Government of Canada, and the Provincial Government of British Columbia met in Prince George to develop an industry-driven sectoral training initiative designed to respond to this need. The result was the Northern Interior Forest Training Initiative (NIFTI). The primary purpose of this program is to accelerate training that meets the needs of the employers and employees in the northern central interior forest industry of British Columbia. This initiative is an example of companies, employees and their unions working together to effectively design and efficiently implement training for the year 2000 and beyond.

• *the primary purpose is to accelerate training*

The NIFTI Consortium focuses on the forest industry, which is the primary employer in the north central area of British Columbia. Anchored by a Workplace Training Consultant from the Open Learning Agency, the NIFTI Action Group identifies the training needs of forest companies. This training is then developed and delivered on a regional basis, be it trades upgrading for electricians or millwrights, basic craft or literacy skills, or industrial management development.

NIFTI, in its raw form, is a highly mobile implementation and design model that is primary-industry responsive and driven with a mandate to provide highly flexible, accessible, cost-effective training and education to a very large, sparsely populated area in the remote British Columbia interior.

• *a highly mobile implementation and design model with a mandate to provide highly flexible, accessible, cost-effective training and education*

THE DELIVERY

Trades upgrading, hydraulics and PLC training for electricians and millwrights was NIFTI's first major training project. This program was aimed at demystifying the trades area, and developing skills and partnerships in the maintenance departments of regional sawmills. More than twenty regional forestry mills have participated in this training program.

Trades upgrading is provided by North Island College's Industrial Mobile Training Unit and the University College of the Cariboo. In this program, trainers do most of the travelling, not the participants. Training group sizes are small, resulting in effective instruction, while the training sessions for several mills are held in one location in order to make the training cost effective.

Training sessions are typically one week in duration, with different levels of training offered in succeeding weeks. The specific levels offered are dependent on the needs of the mills being served by the training session. Resources and format depend on the nature of the skills being transferred. For example, hydraulics training for sawmill technicians is limited to a maximum of ten participants and takes place in a forestry mill and classroom; the PLC training for sawmill technicians has a maximum of eight participants and is offered in a self-contained mobile lab / classroom. The mobile lab is a working model of a sawmill manufacturing facility.

SPECIALIZED RESOURCES

NIFTI is located at the Open Learning Agency Work Place Training Centre in Prince George, British Columbia. In addition to its mobile resources, NIFTI also delivers customer-selected training materials with high tech training resources. These include satellite instruction, teleconferencing, videoconferencing, interactive video disk, CD ROM, and Invest computer labs. Videoconferencing is full motion two way interactive video with either 384 kilbits or Switch 56 technology used from a 1.5 megabyte line. The document camera transmits larger and clearer than life images. Videoconferencing provides two-way access to expertise, training or meetings with minimal expense for time and travel.

NIFTI also has a wide range of specialized resources made available by the industry. In fact, the human resource and training departments of all the private sector forestry partners are available to NIFTI.

The Skills Roadmap Survey, copyrighted by NIFTI, is another example of the specialized resources used in this training program. The Roadmap is an instrument that employees, their supervisors and management complete in order to "map" occupation skills and identify "gaps". Roadmaps are developed for each occupation at each mill site. As a result, each is unique. The roadmap for millwrights at one site contains 58 skills, while the same occupation at another site identifies 117 job-specific skills.

NIFTI has been able to develop and provide this type of cost effective training over a large area by using non-traditional and innovative delivery systems. OLA's experience in non-traditional delivery is perhaps the single most important resource in this program, since without it the delivery would be too expensive for the industry.

UNIQUE ELEMENTS AND BENEFITS

The most unique element of this program is the ongoing participation, cooperation and teamwork of all the partners. Led by the forest industry, the unions, employees,

governments and educational institutions have developed a working partnership to address the training needs that are required to maintain a skilled and competitive forest industry workforce. Providing cost-effective training to upgrade the skills of more than 130 millwrights and electricians in the sparsely populated area of the northern interior of British Columbia has not been an easy task. The progress to date has taken time, extensive research, team building, and a major commitment from all the partners.

• *providing cost-effective training in the sparsely populated area of the northern interior of British Columbia has not been an easy task*

The benefits of this collaboration have been substantial, for all the partners. Employers have increased their employees' skills where it was most required, and the costs have been shared by many mills. Employees have been given access to training programs that will enable them to perform their jobs more effectively and keep pace with changing technology.

The training courses are not pre-set with a standard format. Instead, each is customized and tailored to meet the training requirements specific to each mill. As a result, the mill can use the Roadmap as a basis for selecting and then modifying specific areas for training, rather than purchasing generic training which would have to be followed up on-site with additional training of a more specific nature.

• *the training courses are customized and tailored to meet the training requirements specific to each mill*

DURATION OF TRAINING

To date, more than 130 of 500 targeted millwrights and electricians have graduated from the NIFTI trades upgrading programs. The training is offered twice each year, spring and fall, with sixteen, five-day training courses in each season. Demand for the training is such that sessions are repeated several times.

PARTICIPANTS

All trainees are forest company employees. Most have many years of work experience, and range in age from their early thirties to late fifties. Depending on the program, each of the participants is selected according to assessed level, need for the training, and willingness to participate. Prerequisites are program specific and practical in nature.

ROLE OF PARTNERS

NIFTI is a collaborative effort of forest companies, unions, employees, educational institutions, and the provincial and the federal governments. Industrial partners, to name just a few, include Northwood Pulp and Timber, Lakeland Mills, and Canfor. Labour organizations include IWA-Canada, the Communications, Energy and Paperworkers Union, and the Pulp, Paper and Woodworkers of Canada. The Central Interior Loggers Association is also a key NIFTI partner. Educational and government participants include the Open Learning Agency, College of New Caledonia, the Federal Ministry of Human Resources and Development, and the Provincial Ministry of Skills, Training and Labour.

All the partners assist with infrastructure support, program design, implementation

and delivery strategies, and the overall coordination. All partners are committed to developing and maintaining a highly skilled competitive forest industry. Employers pay for direct training costs, travel expenses, and release time for trainees to attend the program.

TESTIMONIALS

Frank Everitt, President of the IWA-Canada labour organization, feels that the NIFTI program supports the development of a competitive workforce, and "if we are going to be the most competitive we can be in this industry we need everyone's training level raised."

Paul Ramsey, the Member of the Provincial Legislative Assembly for Prince George North, views the NIFTI model as a vehicle that can be replicated elsewhere: "We're building on the NIFTI model for sectoral training across the province."

Finally, a sawmill participant in the NIFTI program describes the benefits of the training program.

> *Technology is advancing so much you need to keep upgrading. Training creates a better work environment, better employees, and better employee relations. It also motivates workers to do better.*

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Telecommunications Technology

offered by

The Southern Alberta Institute of Technology (SAIT)
1301-16th Ave. N.W.
Calgary, Alberta
Canada T2M 0L4

THE PROGRAM

The Southern Alberta Institute of Technology (SAIT) is a recognized leader in the field of telecommunications training. Its two-year diploma program and affiliated international training are acknowledged and widely praised for flexible program design, state-of-the-art equipment, highly qualified teaching personnel, and industry linkages

• *a recognized leader in the field of telecommunications training*

Areas of specialization in this program include voice and data communications, microcomputers and signal transmission using mobile radios, microwave switching, multiplexing, and fibre optic facilities. The program accepts between fifty and sixty students annually, after they have completed a foundation semester which focuses on introductory principles of electronics, autoCAD applications, and fundamental mathematics and communication skills.

Thailand and Mexico, two countries that suffer from a serious shortfall in the labour pool of qualified telecommunications personnel at the technologist level, approached SAIT with a request to develop and deliver custom-designed in-country telecommunications training. The development of the training programs was spearheaded by SAIT, with support from and in cooperation with private sector organizations that include Nova Corp International, Northern Telecom (Canada) Ltd. and AGT. These custom-designed telecommunications technology training programs are based on SAIT's regular two-year diploma program with adaptations that reflect the in-country needs of Thailand and Mexico.

SAIT works with the Department of Vocational Education (DOVE) in Thailand, and with GRUPO IUSACELL in Mexico. Although SAIT's partner institutions are quite different - DOVE is a branch of Thailand's Ministry of Education and IUSACELL is a company within a multi-focused corporation - the basic principles on which these programs are based is similar. These include a strong commitment to "hands-on" technical instruction as an effective training strategy, the belief that training can and should be a "value-added" commodity, and the integration of training within a labour market context. The Thai colleges participating in this program, under the coordination of DOVE, are located in Lampang, Khon Kaen, Hat Yai, Don Muang (in greater Bangkok), and Chacheongaaao.

• *a strong commitment to "hands-on" technical instruction as an effective training strategy*

THE DELIVERY

The regular Telecom program offered by SAIT is a two-year, four-semester diploma program, heavily dependent on specialized telecommunications labs. Specialized

telecommunications courses offered to industry are customized to meet the needs of the client. The Industrial Manufacturing Technology Program in telecommunications, offered to NT employees, is 1,874 hours in duration

• *the transfer of this technology training is based on a "train-the-trainer" premise and the concept of joint development*

The transfer of this technology training is based on a "train-the-trainer" premise and the concept of joint development. Therefore, in both cases, Thailand and Mexico, linkages have been developed between SAIT and targeted institutions in the host countries. These linkages involve several applied activities, including: the joint development of curriculum and training techniques that directly address the expressed needs of the Thai and Mexican labour markets; the implementation of the curriculum within the partner institutions, delivered primarily by host country faculty with support from SAIT faculty; fellowship programs, delivered at SAIT, which stress technical assessment and upgrading in major telecommunications content areas; Canadian private sector technical specialists working in the Thai and Mexican educational contexts with the goal of developing relationships between the training programs and local industry; on-going technical seminars, both in Canada and in the partner countries, to build on the technical base and to transfer the training program to other colleges and training institutions in Thailand and Mexico.

SPECIALIZED RESOURCES

This program is supported by more than forty specialized teaching and demonstration labs including the Meridian 1 Education Centre which provides a complete private branch exchange dedicated to training postsecondary students and industry clients. This centre was developed by a private sector partner, Northern Telecom (NT), in partnership with SAIT. In 1992, NT and SAIT inaugurated a joint diploma in Industrial Manufacturing Technology (Telecommunications) for NT employees.

Thai partner institutions work with lab Volt training systems to ensure that basic technical competencies are achieved by all students completing the program. Each participating Thai college is integrating the acquisition of highly specialized equipment, including building additions and modifications, concurrent with the implementation of the program.

Mexican participants train in the well-equipped SAIT laboratories. In addition, hands-on site training takes place at Northern Telecom's wireless production facility in Calgary. This "Centre of Excellence" is producing the cellular equipment to be installed in the 100 plus designated "cells" in Mexico City.

UNIQUE ELEMENTS AND BENEFITS

A unique aspect of this training is the way it incorporates and builds working partnerships between the training institutions and local industry. This element, proven highly successful in Canada, assures purpose, focus and validity to the training.

Industry advisory committees are used to develop and encourage program involvement through the provision of on-the-job training placements, validation of curriculum units, employment of program graduates, and sponsorship of current employees for technical upgrading.

In Thailand, this program will be the basis for the establishment of national standards in telecommunications technology training. As a result, employers will have a clear and detailed knowledge of the skills of telecommunications graduates. In Mexico, the program will decrease the reliance of the telecommunications industry on ex-patriate expertise.

DURATION OF TRAINING

The regular program, as noted earlier, is two years in duration. Customized programs, offered to and in partnership with industry, vary in length.

The Thai training project is three years in duration. In the first year, Thai instructors spent an intensive twenty-one weeks at SAIT. In subsequent years, approximately twenty-five weeks per year is devoted to training, with half of that in Canada and the rest in Thailand. Curriculum development and industry consultation activities occur throughout the program.

In Mexico, the training is shorter in duration and more focused in nature. Typical training sessions range from five to twenty days of instruction. These are delivered according to a predetermined schedule over the two-year, first phase of this project.

PARTICIPANTS

Participants in the Thai program include twenty DOVE instructors who are teaching electronics and introductory telecommunications. Most hold Bachelors degrees in Electrical Engineering from Thai universities and have from two to fifteen years teaching experience. All have received upgrading in English, both in Thailand and in Canada. The five Thai colleges involved in the program enrol two hundred students in telecommunications training.

The Mexican participants are employees of GRUPO IUSACELL. Most hold a Bachelors degree and some are company supervisors.

ROLE OF PARTNERS

Canadian partners are drawn from the private sector. Their role includes supplying technical specialists for assignment in Thailand and Mexico, making technical facilities in Canada available for site visits and more extended practicum placements, hosting technical tours, seminars and social activities, and acting as champions for the project. SAIT's partners include Novacorp International, AGT Limited, Northern Telecom Canada, the Telecommunications Authority of Thailand, Chulalongkorn University (Bangkok), and Telecom Asia.

• *Canadian partners are drawn from the private sector*

In Thailand and Mexico, partners include the colleges and private sector employers. The colleges' role includes participating in all the development activities, cultivating and sustaining meaningful contact with the private sector, and serving as resource-centres from which the training will spread to other colleges.

The National Advisory Committee in Thailand includes ten to fifteen senior executives representing major telecommunications companies, ministries, and government regulatory bodies. Each Thai college is supported by a regional advisory committee.

The private sector role includes providing advice on curriculum development, providing on-the-job training sites, and employing program graduates.

TESTIMONIALS

Mr. W.C. Thompson, Novacorp International Vice President for Asia/Pacific, is a strong supporter of the program. He believes SAIT is well positioned with the appropriate resources.

> *Novacorp believes SAIT has the advanced technical education capabilities to provide for this project and with the support of Canadian Industry will consummate a linkage that can serve well, both Thailand and Canada.*

In Thailand, Dr. Prasit Prapinmongkolkarn, Director of Chula Unisearch and communications Professor at Chulalongkorn University, said,

> *This partnership will help reduce the shortage of manpower in telecommunications ...*

This was echoed by Mr. Suthipong Promsutt, Head of the Communications Engineering Division of the Petroleum Authority of Thailand.

> *I believe that the partnership between SAIT and Thailand's Department of Vocational Education will allow Thailand to produce competent graduates in the field of telecommunications technology that will help relieve the shortage of manpower in this field.*

Mr. Doug Clark, Northern Telecom Canada's General Manager for Mexico, described his enthusiasm for the Mexico training project.

> *I hope you share my enthusiasm for this "value-added" project. It represents a potential "win" for all involved - IUSA, N.T., Canada and Mexico as it attacks the fundamental problem of developing human capital shortfalls.*

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Mechanical Engineering
Diploma Program

offered by

National Kaohsiung Institute of Technology (NKIT)
415 Chien Kung Road
Kaohsiung 80782
Chinese Taipei

THE PROGRAM

The Mechanical Engineering Department of NKIT was established in 1965 to train personnel in power, manufacturing, design, and materials. Within the department, the mechanical engineering diploma can now be pursued through four different programs, the five-year, the two-year, the two-year Night Division, or the affiliated two-year Supplementary. Graduates receive a diploma which includes the appropriate five-year, two-year, or Night designation. Certificates are granted to graduates of the Supplementary program.

Many graduates of both the five-year and two-year programs continue with their studies at university where they are granted advanced standing. Two years at university can lead to an undergraduate degree and an additional two years to a graduate degree. NKIT graduates are well prepared for advanced studies.

Graduates of the mechanical engineering program obtain employment in mechanical design, manufacturing, installation operations, and inspection.

THE DELIVERY

The program integrates classroom with laboratory instruction. In addition, students are exposed to practices at local industries through field visits arranged by faculty.

SPECIALIZED RESOURCES

Students receive current, up-to-date instruction in the Institute's many well-equipped labs. Specific examples include wood pattern, CAD/CAM, foundry (with precision casting), lathe and bench work, synthetic machine (with lathe, bench, and grinder), welding/sheet metal, CNC, automatic control, forging, and laser labs.

UNIQUE ELEMENTS AND BENEFITS

The variety of programming options - five-year, two-year day, two-year night, etc. - allow participants to take advantage of the training in many different modes. This flexibility is key to encouraging applications from as many qualified students as possible, thereby maximizing the Institute's effort to ensure the labour market is

• *the variety of programming options is key to encouraging applications from as many qualified students as possible*

appropriately supplied with trained professionals. The university linkage program, the availability of peer tutoring, the integration with local industry through field trips, the flexible scheduling, and the scholarships donated by public and private industries and the NKIT alumni association (available to exceptional students) are significant elements of this program.

DURATION OF TRAINING

The five- and two-year programs take five and two years, respectively, to complete. The two-year Night Division program takes three years to complete as the participants are working full-time. Similarly, the two-year Supplementary program, which offers classes on weekends, takes three years to complete.

The hours of instruction per week vary depending on the individual student, but the range is between 20 and 30. The chairperson performs an advisory role with students and arranges flexible schedules to accommodate individual needs and promote academic success.

• *flexible schedules accommodate individual needs and promote academic success*

PARTICIPANTS

Applicants to the five-year program must complete junior high school and pass the joint junior college entrance examination prior to admission. Senior technical high school or senior high school graduates are eligible for admission to the two-year program after passing a preliminary standard measurement of academic achievement, conduct, and health. Applicants who are graduates of a senior technical high school and who have been working for at least one year become eligible for admission to the two-year Night Division after passing the joint entrance examination for the two-year evening course. While most participants in the Night Division are working during the day, unemployed persons are also admitted. Graduates of senior technical high schools or senior high schools who complete the joint entrance examination are also eligible for the Supplementary program.

There are approximately 100 full-time day, 100 evening, and 100 new supplementary students each year.

ROLE OF PARTNERS

Part-time teachers are recruited from industry, other colleges and institutes, and universities. They bring a wealth of practical experience to the program. Many employers provide release time for full-time employees who wish to attend the Institute. Because of their practical experience, these mature students contribute fresh ideas and questions to the classroom, creating a dynamic learning environment.

TESTIMONIALS

Shou Ching-Rong, a 1979 graduate of the five-year program, who is now the NKIT technician responsible for the CNC and turning labs, describes the advantages of combining theory with practical training.

In the relatively short term of five years, the program delivers the skills required by the industrial community. Graduates not only understand mechanical engineering theory, they also possess the practical skills required for success in the workplace. The applied part of the program gives students essential practical skills, while the significant theory component allows them to understand the "whys" of the job they will be performing.

Shiehe Chong Ming, a part-time teacher in the program, praises NKIT's "exceptional facilities", and Professor Wu, a full-time faculty member in the mechanical engineering department, adds that,

Students are able to choose from among several options including CAD/CAM, laser, electrical discharge processing, powder metallurgy, and logic design. This allows them to specialize in their area of interest.

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Chemical Engineering
China American Petrochemical Co-operation

offered by

National Kaohsiung Institute of Technology (NKIT)
415 Chien Kung Road
Kaohsiung 80782
Chinese Taipei

THE PROGRAM

Approximately ten years, ago the National Kaohsiung Institute of Technology was approached by the China American Petrochemical Company Limited to develop a program which would train technicians for a variety of technical roles within the Chemical Engineering Department of the company. Since the initial contact was made, NKIT has offered the customized training program five times. With each successive delivery, the curriculum has been modified to meet the changing demands of China American. Close cooperation on curriculum development between NKIT's faculty and company engineers has been a critical element in the success of the program.

Though specific content often changes, general subjects include chemical equivalent apparatus, computer control, industrial safety, electrical equivalent, industrial chemistry, industrial instrumentation, quality control, basic electronics, basic industrial English, organic chemistry, and experiments in unit operations and computers.

THE DELIVERY

• *up to one-third of the training is conducted in China American's factory*

Most of the training is done at NKIT where students have access to excellent facilities. Up to one-third of the training is conducted in China American's factory.

In addition to specialized courses developed in cooperation with China American, students complete the basic chemical engineering courses offered in traditional diploma programs at NKIT. The program is intensive. Students attend classes 35-40 hours per week and devote additional time to out-of-class assignments. During the first term, students spend two-thirds of their time in class and one-third in the labs. These proportions are reversed during the second term.

SPECIALIZED RESOURCES

Courses are taught by full-time faculty from NKIT as well as engineers from China American. This combination has proved to be very powerful as it ensures both a generalist overview and applied specializations. Equipment used in the delivery of the program includes a centrifugal pump apparatus, double pipe heat exchanger, boiler, and pipe water flow system.

UNIQUE ELEMENTS AND BENEFITS

Because the program is modified each time it is delivered, participants receive only the most up-to-date training. Prior to each new session faculty and company engineers meet to discuss curriculum revisions, thus ensuring that graduates have the theoretical knowledge and practical skills currently required by the company.

These curriculum updating sessions help ensure that NKIT faculty stay abreast of changes in the chemical engineering field.

DURATION OF TRAINING

The program consists of two, thirteen-week semesters. Students must complete 1,066 hours of instruction prior to certification as technicians. Most courses are three or four hours per week.

PARTICIPANTS

The basic prerequisite admission requirement is senior high school, though most participants have at least some college or university training. Some participants already have jobs with China American, while others will begin working only after they complete the training program.

The first of the five sessions enrolled 60 students, while the current group has 35 participants. The smaller classes reflect the willingness of both partners to respond to feedback and make changes that ensure a quality program. Of the 35 students who are currently enrolled, 15 are senior high school graduates, 18 are junior college graduates and two are university graduates. All are full-time day students.

ROLE OF PARTNERS

China-American Petrochemical provides jobs, financial support and curriculum development expertise. The government also provides a training allowance.

TESTIMONIALS

Dr. Jiin-Jiang Jow, Director of Practice & Placement Service at NKIT, endorses the program as follows:

> *China-American Petroleum is a very good company. All the graduates of the co-operation program are guaranteed a job with the company, and will earn a very good salary, even in their first year of employment. Because the program is delivered co-operatively by professors from NKIT and engineers from the China-American Petroleum Company, it includes both theoretical and practical training, enabling graduates to adapt to the world of work very quickly. In addition, the latter part of the training is delivered in the factory, consequently graduates are already familiar with the company's policies and procedures and adapt easily to their new positions.*

• *all the graduates are guaranteed a job with the company, and will earn a very good salary*

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Mechanical Engineering
Bachelor of Science Degree Program

offered by

National Pingtung Polytechnic Institute (NPPI)
1 Hsuehfu Road
Neipu Hsiang, Pingtung Hsien 91207
Chinese Taipei

THE PROGRAM

Established 30 years ago as a Junior College, the National Pingtung Institute of Agriculture became the National Pingtung Polytechnic Institute in July, 1991. In keeping with this change, the Department of Agricultural Mechanical Engineering became the Department of Mechanical Engineering. Graduates of this department receive a Bachelor of Science degree in Mechanical Engineering at the end of the two years and become eligible to pursue a Master of Science degree in Mechanical Engineering, also offered by the Institute. Approximately 10% of the two-year graduates continue with graduate studies at NPPI or at other institutions. With or without graduate degrees, NPPI alumni are well prepared to compete in today's global market.

The engineering sciences program includes courses in thermo-fluid, control/dynamics, design/manufacturing and agricultural machinery. Through elective courses students can pursue specialised interests related to their career paths or prepare for graduate study.

Graduates obtain employment in engineering and research in a wide variety of fields, including agriculture, automotive and plastics.

THE DELIVERY

Classes are held at the Institute, where students have access to the most up-to-date laboratory facilities. Courses are taught by twenty-five full-time faculty who perform the dual role of teaching and research. Faculty are specialists in a number of areas, including aerodynamics, fluid mechanics, thermodynamics, hydraulic and pneumatic control, agricultural machinery, optic-electron engineering, telemetry, internal combustion engines, and waste management.

• *faculty perform the dual role of teaching and research*

Representatives from the industrial office of the central government and other ministries visit NPPI in order to make students aware of the current employment situation in the industrial sector. Field trips are arranged to give students an opportunity to investigate various career possibilities.

SPECIALIZED RESOURCES

Well equipped laboratories such as thermal engineering, fluid mechanics, CAD/CAM, computational mechanics, vibration and dynamic control, precision measuring, automatic control, materials testing, industrial electronics, hydraulics and pneumatics, and electrical engineering provide an excellent learning environment for students.

• *since 1991 more than 75 research projects have been conducted*

Faculty have published a wide variety of refereed papers in recent years and have presented papers at more than 20 conferences, both in Taiwan and abroad. Since 1991 more than 75 research projects have been conducted. These include studies on agricultural waste management, automation of agricultural processes, improved food production, and non-destructive testing methods.

UNIQUE ELEMENTS AND BENEFITS

NPPI has the financial resources necessary to pursue its extensive research activities and students in the undergraduate program benefit through their participation in these projects. Research is devoted to issues such as the design and automation process specifically looking at CAD/CAM, automation of manufacturing, vibration diagnosis and noise prevention, and the automation of agriculture. Also included in the research agenda is the theory and application of thermo-fluid systems, encompassing fluid machinery, control of thermo-fluid systems, the application of energy, and combustion. Research on waste material processing is particularly important.

DURATION OF TRAINING

Undergraduates must earn at least 72 credit hours during the two-year program. One credit hour is equivalent to one hour of lecture or two hours of lab or tutorial per week.

PARTICIPANTS

Prior to entering the program, students must complete four or five years at a junior college and pass the Institute's entrance examination. At any given time, there are approximately 300 students enrolled in the undergraduate program. Every September, 150 new, full-time day students enrol.

ROLE OF PARTNERS

Research activities are funded by, among others, the Industrial Development Bureau, the Council of Agriculture, the National Science Council, the Food Bureau, and the Ministry of Education. The financial support of these partners provides a unique opportunity for students to participate in agricultural research.

Many private companies have performance and other quality control tests performed in the Institute's exceptional materials testing lab, providing students with an opportunity to apply their extensive theoretical knowledge.

TESTIMONIALS

The Chairman of the Department, Hsieh Ching-Chen has praised the practical nature of the Institute's extensive research activities.

> *The goal of the NPPI's Mechanical Engineering Department is automated production and effective waste management. The two-year program effectively integrates theory with practical skills so that all graduates who seek employment find good jobs. The placement rate is one hundred percent.*

Lin Yi-Hong, Associate Professor, argues that the research activities associated with this program produce practical skills.

> *The emphasis in this program is on practical mechanical engineering research and design used in industry. The requirement that students be involved in research activities at the Institute ensures that they acquire the practical skills they need to be effective in today's market.*

The program was profiled in the June, 1993 issue of *Mechanical Engineering*, a prestigious bi-monthly magazine published by the Association of Mechanical Engineers Society.

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Manufacturing Technology
Electrical, Mechanical & Automation Technology Certificate

offered at

National Taipei Institute of Technology (NTIT)
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Taipei, 10643
Chinese Taipei

THE PROGRAM

Since 1972 the Practice and Placement Service Centre at NTIT has conducted unique, customized cooperative education programs with both public and private industries. Partner companies send employees to NTIT for one to two years of part-time or full-time training and, upon completion of the training, participants return to their jobs with enhanced technical skills and theoretical knowledge.

In 1992 the National Taipei Institute of Technology collaborated with Teco Electric & Machinery Company to develop the Electrical, Mechanical & Automation Technology Certificate as the foundation for the Teco Enterprise University. Teco, during the past forty years, has grown to become one of the twenty largest private sector firms in Chinese Taipei. It encompasses a host of subsidiaries, including United Microelectrics, Tecom, Yuan Tung Venture Capital, Royal Taiwan, Toshiba Compressor (Taiwan), and Teco Investment Systems.

Designed to train senior technicians for Teco, this two-year program emphasizes a fundamental understanding of electronics, electrical technology, mechanical technology, computer languages, communications and mathematics. Graduates of the program are prepared to solve today's technical problems and to pursue tomorrow's technological advancements.

THE DELIVERY

Classes are conducted on-campus, where participants have access to NTIT's specialized laboratories and workshops. In order to accommodate the work schedules of Teco Electric & Machinery Company employees, the classes are held on Saturdays. If Saturday is a workday, the classes are held on Sundays.

• *if Saturday is a workday, the classes are held on Sundays*

Tuition is paid by Teco, and the company subsidizes 60% of the cost of textbooks and other learning aids.

SPECIALIZED RESOURCES

By using the exceptional facilities in both the mechanical and electrical engineering departments, NTIT has been able to deliver this program without a large investment

in new resources. No new laboratory equipment or instructional materials are required as the program is comprised of already existing courses in electrical, mechanical, and electronic engineering and mathematics.

The laboratories and workshops of the mechanical engineering department include hydraulic and pneumatic, materials testing, thermal engineering, fluid mechanics, solid mechanics, heat treatment, internal combustion engine, precision measurement, CAD, foundry and pattern, welding, sheet metal, NC machine, CAM, and auto. Significant equipment includes pneumatic and hydraulic equipment, an FFT analyzer, universal testing machine, 3D measuring bed, CNC machine, laser cutter, induction furnace, power plant, FAS and Mini-CIM.

The electrical engineering department's laboratories include fundamental electricity, electrical instruments, residential wiring, industrial power distribution, illumination testing, electrical machinery, H.V. engineering, automatic control, programmable controller, logic design, industrial electronics, optoelectronics & laser, software programming, microcomputers, refrigeration engineering, and energy research. Significant equipment includes a large scale short circuit testing device, noise signal analyzer, automatic measurement system for electrical machinery, computer network system, digital control system with microcomputer-aided CO2 and YAG laser manufacturing system.

Classes are taught by NTIT's experienced and enthusiastic faculty. Approximately 75% of the faculty hold doctoral or master's degrees and more than 50% have pursued advanced studies abroad. To improve the quality of its faculty, the Institute provides powerful incentives to encourage interested faculty to pursue advanced studies.

• *the Institute provides incentives to encourage interested faculty to pursue advanced studies*

UNIQUE ELEMENTS AND BENEFITS

Mutual benefit is derived from the integration of theory with practice by both the teachers and the participants. Employees of the Teco Electric & Machinery Company are able to relate the theory and practical work in the classroom directly to the jobs they perform for Teco.

Through this technical training program, NTIT has established a good working relationship with Teco. The partnership is a good model for other linkages between the Institute and industry.

On successful completion, students receive a certificate stating the number of credits earned. Also, position on the salary scale and increments are adjusted. Students who withdraw are required to pay the school fees.

DURATION OF TRAINING

This certificate program is designed as a 36 credit hour course of study. Participants average nine credit hours of study per semester for each of four semesters. NTIT semesters are 18 weeks in length. A one credit hour course meets for one hour of lecture plus lab for a total of 18 weeks.

PARTICIPANTS

Approximately, forty students are enrolled in the Electrical stream, twenty in the Mechanical stream, and thirty in the Automation stream. All are part-time students as they are employed full-time by Teco. Participants must have completed two years of service with Teco and be high school graduates.

ROLE OF PARTNERS

Teco's investment in release time, tuition and books has been considerable. The company also provides scholarships for the top three outstanding students in each of the four semesters. By using the Teco University Program as a model for linkages with the private sector, NTIT has been able to profile its flexibility and commitment to industry.

TESTIMONIALS

The President of Teco has stressed that the Taipei Institute of Technology has made a significant contribution to the company in the area of human resource development. While the company is expanding into international markets, it urgently needs qualified staff. NTIT is recognized as an institution capable of effectively combining theory and practice in order to upgrade the skills of practising technicians.

A senior official at Teco, when asked to comment on the training program, noted,

> *Under our GM's direction, and our continual effort to employ first-rate personnel, we have cooperated with NTIT to add technical expertise to the company. Since working with NTIT, we have been successful in achieving our training targets. This is a result of NTIT's leadership, planning, instructional capability and efficiency. We are thankful to NTIT for raising our production standards ... and are planning on approaching NTIT to discuss further cooperation.*

Ted M. H. Huang, Chairman of the Board at Teco, when discussing the internationalization of the company, has said "Teco will continue to refine its appreciation of the human resources dimensions of internationalization". Clearly, there will be increased opportunities for technical training and updating contributions, and NTIT in particular, to support companies such as Teco.

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Mechanical Turning Program

offered by

Southern Vocational Training Centre (SVTC)
Employment & Vocational Training Administration
Council of Labour Affairs
No. 2-1 Kai-shuan 4th Road Chien-Chen
Kaohsiung
Chinese Taipei

THE PROGRAM

The Southern Vocational Training Centre was established by the Ministry of Economic Affairs to provide applied skill training which leads directly to industrial employment. Consequently, all programs offered at the Centre emphasize vocational training required by an evolving marketplace. Upon completion of coursework in the Turning Program, students write a skill licensing examination. If successful, graduates are then ready to enter the workforce. The skill qualification tests and job placement assistance are managed by the Centre.

THE DELIVERY

The emphasis at the Centre is on practical skill training and the method of delivery focuses on a hands-on approach. Classes are small, never exceeding 25 students. All students have their own machines or workspaces in the shops. Theory constitutes not more than 30% of the curriculum; the remainder of the time is devoted to practical exercises in the labs. All classroom and lab instruction is delivered by full-time faculty.

• *classes are small, never exceeding 25 students*

SPECIALIZED RESOURCES

In addition to using the turning machines for approximately 80% of the credit hours, students are also exposed to milling, fitting and numerical control machinery. Equipment updates are generously provided by the government.

UNIQUE ELEMENTS AND BENEFITS

Students in the turning program acquire very practical, applied, and up-to-date skills in a relatively short period of time. Graduates are job-ready, and the Centre assists with placement.

At the request of various companies, China Steel for example, the Centre customizes programs to meet industry's needs. The customized programs are usually one or two months in duration and the partner company continues to pay the salaries of the participants. The company also pays the cost of materials, books, and the instructors' salaries.

DURATION OF TRAINING

There are two options within the turning program, one is six months in duration and the other is a full year. Students in the six month option must complete 900 hours, whereas in the one year program they must complete 1800 hours. The six month program usually starts in July, and the one year program begins in September.

PARTICIPANTS

Graduates of senior or vocational high schools may enter the six month program. Participants in the one-year program must have completed junior high school. Classes are scheduled for eight hours per day, five and a half days per week. Up to 25 students are enrolled in each of the two programs at any given time.

• *classes are scheduled for eight hours per day, five and a half days per week*

ROLE OF PARTNERS

The government meets with advisors from business and industry regularly to ensure that curriculum is relevant and meets the needs of the workplace.

TESTIMONIALS

Sun Kuang-Hsiung, Department Chief of Training – Staff Unit, says,

> *This Centre provides students who do not possess any qualifications with the skills they need in order to get a job. If their skills are exceptional they are sent to international competitions and may become eligible to enter university. In addition, students who succeed in national competitions can enter junior college. In other words, students can choose to continue with their studies or obtain a good job as a result of the skills they acquire here at the Centre. However, above all other considerations, the purpose of our training goes beyond simply meeting the technical manpower needs of business and industry. Our goal is to elevate the worker's skill levels broadly and thoroughly. Rewards, such as university entrance, are primarily used to promote a diligent, industrious and unflagging approach to the studies.*

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Integrated Circuit (IC) Fabrication
Semiconductor Technology Training Program

offered by

Tze-Chiang Foundation of Science & Technology (TCFST)
101, Section 2, Kuang Fu Road
Hsinchu 30043
Chinese Taipei

THE PROGRAM

Tze-Chiang Foundation of Science and Technology (TCFST), a non-profit organization, was founded in 1973 by alumni from National Tsing Hua University with the goal of integrating the academic expertise and facilities at the University with the research activities of science and technology-based industries.

In 1986 TCFST was appointed by the administration of Hsinchu Science-Based Industrial Park to set up a Semiconductor Engineering Training Centre. Since then, more than ten thousand engineers have been trained at the Centre.

The program has received support from the Industrial Bureau of the Ministry of Economic Affairs since 1990 and from the Employment and Vocational Training Administration of the Council of Labour Affairs (Executive Yuan) since 1992.

Most of the instructional staff and advisory board members of the training program are from the National Tsing Hua University. Additionally, based on recommendations from advisory board members, instructors from industry and academic institutions abroad are recruited into the program. Instructors are selected for their specific applied and research expertise. All are at the forefront of developmental research in the industry.

• *instructors are at the forefront of developmental research in the industry*

The semiconductor technology training program focuses on device physics and modelling, circuit design and analysis, circuit layout, IC process technology and simulation, testing and reliability, and equipment and facility maintenance for wafer fabrication.

THE DELIVERY

The elementary training courses are delivered primarily through classroom lectures. Participants in these courses are engineers whose majors are outside the field of electrical engineering.

For experienced participants with electrical engineering backgrounds, advanced courses are offered. Lab practice in these courses is delivered with the aid of CAD

and computer simulation practice with PC's or work stations, and process practice in class 100 and class 10 clean rooms.

SPECIALIZED RESOURCES

Specialized equipment used in the delivery of the training includes design/simulation equipment (PC's and work stations), and semiconductor process equipment including mask Algiers, high-temperature furnace systems, CVD systems, sputter deposition systems, chemical stations, dry etching systems, ion implanters, and photo-resist coating systems. Analysis/testing equipment includes SEM, TEM, SRP, four-point probe, ellipsometer, I-V, and C-V measurements. Clean room specifications, critical to IC fabrication, are met with better than class 100 facilities.

In keeping with its commitment to long-term cooperation, the TCFST shares the CAD and material and electric characterization laboratories of the National Tsing Hua University.

UNIQUE ELEMENTS AND BENEFITS

This industry-oriented program receives 50% of its financial support from the government, most notably the Industrial Bureau of the Ministry of Economic Affairs. Students benefit from a relatively low course fee as well as the expertise of lecturers from both local and overseas companies and universities. Cooperative partners include local and international institutes such as the National Tsing Hua University, Electronic Research & Service Organization (ERSO) of the Industrial Technology Research Institute in Taiwan, the University of California at Berkeley, and Evans-Asia in Hong Kong.

The IC professors at the National Tsing Hua University regularly invite a wide variety of guest speakers and lecturers from among the ranks of the senior engineers in local companies to participate in the delivery of the courses. In this way, the program is directly relevant and current with developments in the industry.

The rapid development of the IC industry in Chinese Taipei has created a serious shortage of experienced labour at the engineering level. This program responds directly to this shortage by providing training for engineers who want to move into the IC field as well as continuing education upgrading opportunities for professionals who are currently working in the field. As a result, the technological capabilities of local IC companies are constantly being improved through the training provided by the TCFST.

DURATION OF TRAINING

Basic courses are usually three hours per week during the evenings, totalling thirty instructional hours. Lab practice varies from eighteen to forty-eight hours, and can be completed during the day or evening. Special or advanced programs are offered during the day, and vary from six to eighteen hours in duration. This flexible approach to course programming ensures that the training is accessible to engineering professionals who are working in the industry.

PARTICIPANTS

The educational background of the participants varies from college diploma holders to those with postgraduate degrees. Of the one thousand participants per year, approximately 20% hold college diplomas, 40% hold undergraduate degrees, 35% hold masters degees, and 5% hold doctoral degrees.

Most of the participants are young, in the range of twenty to thirty-five years of age. About 80% of the participants work for firms located in Hsinchu Science-Based Industrial Park. Special courses are provided for TCFST's many cooperative partners, including Taiwan Semiconductor Manufacturing Company, Texas Instruments-Acer Incorporated, Mosel Vitelic Inc., and United Microelectronics Corporation.

ROLE OF PARTNERS

The unique relationship between the TCFST and its partners, both in Taiwan and in other countries, is one of the major driving forces sustaining TCFST's success in the field of semiconductor technology. In addition to the Industrial Development Bureau of the Ministry of Economic Affairs, the Employment and Vocational Training Administration of the Council of Labour Affairs (Executive Yuan) and Hsinchu Science-Based Industrial Park Administration are major sources of financial support for TCFST.

• *the relationship between the TCFST and its partners is one of the major driving forces sustaining TCFST's success in the field of semiconductor technology*

The National Tsing Hua University provides lecturers and equipment support, ERSO provides lecturer support, and the University of California at Berkeley provides lecturers for short, intensive workshops.

TESTIMONIALS

The specialized training offered by Tze-Chiang is enthusiastically endorsed by the companies in Hsinchu's Science-Based Industrial Park. For example, Dr. Nan-Shyong Tsai, Vice President of MOSEL VITELIC Inc., has said,

> *This program really meets the wide variety of needs, including design, processing and maintenance, of local companies.*

And Ms. Y. O. You, Division Manager of Product Development for Hualon Microelectronics Company, has noted that,

> *This program provides a convenient and efficient means of self-promotion for local engineers.*

Dr. Neng-Shyan Tsai, Director of the R & D Division at Taiwan Semiconductor Manufacturing Company, describes TCFST's training program as solving "the urgent need for manpower in Taiwan's IC industry."

In an evaluation made by National Cheng Chi University, through contract from the Hsinchu Science-Based Industrial Park, TCFST's Semiconductor Training Program was cited,

> *as highly successful in performance. The strong and interconnected relationship between the IC industry and the program can be applied as a model system for other high-tech industries. The great demand for manpower in the IC industry has made the continuous development of the training program necessary and worthwhile.*

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Electronic Design Automation
ASIC & Electronic System Design

offered by

Electronic Design Technology Training Centre
Vocational Training Council
13/F, VTC Tower, 27 Wood Road
Wanchai, Hong Kong

THE PROGRAM

The escalating movement of manufacturing from Hong Kong to China, coupled with increasing global competition, has encouraged the electronic industries in Hong Kong to move away from commodities based manufacturing into the field of high value-added engineering and marketing. One approach to this end is through the development of EDA (Electronic Design Automation) expertise. As a result, the Electronic Design Technology Training Centre (EDTTC) was established in 1990 by Hong Kong's Vocational Training Council with the objective of providing training in ASIC and Electronic System Design to practising engineers.

• *instructors are at the cutting edge of the industry*

The Centre works closely with the five universities in Hong Kong, drawing some of its instructional staff and advisory board members from those institutions. Many of these instructors were recruited by the universities from industries and academic institutions abroad. These instructors are selected on the basis of applied and research knowledge that is at the cutting edge of the industry.

Currently, the EDTTC provides courses in Programmable Logic Devices, Programmable Data Array, Gate Array & Standard Cell Design, Modular ASIC, Advanced ASIC, Embedded Controllers, Printed Circuit Boards, Computer Engineering, Testing, and Telecommunications.

The EDTCC also provides short courses to students from tertiary institutions in Hong Kong as well as self-learning modules for practising engineers who use the Centre's equipment and study booklets to carry out research and self-directed learning projects.

THE DELIVERY

The programs for practising engineers are offered on a part-time basis, and utilize lectures, tutorials, lab work and assignments. During these courses, participants are required to complete a major project or lab exercise designed to develop practical understanding and application expertise. For example, in the Gate Array and Standard Cell Design courses, participants are required to design a functional chip. This design is then manufactured in a prototype form.

The short term intensive courses for engineering students enroled at tertiary institu-

tions in Hong Kong are generally one week in duration and provide an introduction to the field of ASIC design and development.

SPECIALIZED RESOURCES

Key equipment used in the delivery of EDTCC training includes networked SUN work stations, PCs, IC CAD tools, HDL and VHDL simulators and logic synthesizers, test compilers, PSpice circuit simulators, CAE tools, PLD programmers, EPLD design software packages, PGA design software and programmers from Lilinx and Actel Corporation, IMS SL/60 IC tester, colour plotters and laser printers.

• the Centre has satellite sites at the tertiary institutions with which it is affiliated

The Centre operates from a central site at the VTC Tower in Wanchai, but also has satellite sites at each of the tertiary institutions with which it is affiliated. These are linked to the central site through a WAN. Project work in the fields of Gate Array Design and Standard Cell Design is normally carried out at the satellite sites.

UNIQUE ELEMENTS AND BENEFITS

Each course offered by the Centre is characterized by rich, hands-on, cutting edge, practical work. Course participants acquire design technology skills that are immediately and directly applicable to their day-to-day work in the industry. As a result, the Hong Kong electronics industry benefits from a ready supply of technically updated engineers who are at the forefront of IC technology.

• instructors are intimately familiar with specific, highly technical software

Although many of the instructors are drawn from Hong Kong's tertiary institutions, and a good number of these are from outside Hong Kong and have been recruited for their exceptional expertise, other instructors are Hong Kong nationals hired directly from software organizations in Hong Kong. Here, the goal is to use instructors who are intimately familiar with specific, highly technical software, and are thus able to answer the most detailed questions not only about how to use the software but also about how the software itself has been developed and how it operates. In order to minimize conflicts of interest when instructors come directly from software companies, EDTTC ensures that the participants have an opportunity to see a range of software products. The Centre also reviews and edits the training materials.

DURATION OF TRAINING

The courses for practising engineers last from 18 hours to 174 hours, the longer courses being in the fields of Gate Array Design and Standard Cell Design. Most participants in these courses study for one evening per week and all day Saturday. Since most Hong Kong commercial organizations, excepting the U.S. corporations, operate on a five and one half day work week, the Saturday program is typically a work release activity.

PARTICIPANTS

Practising engineers are the main client group, of whom approximately 10% hold graduate degrees, 70% hold Bachelor Degrees and 20% hold Diplomas or

Certificates. The Centre provides training for approximately 400 of these participants each year. Most are early on in their careers - twenty to thirty years of age - and work for firms that include National Semi-Conductor, Toshiba, Texas Instruments, Motorola, Video Technology (HK), NEC and OKI.

As well, 380 engineering students are trained each year at the Centre.

ROLE OF PARTNERS

The training Centre was set up by the Vocational Training Council in collaboration with government, industry, the University of Hong Kong, the Chinese University of Hong Kong, the Hong Kong University of Science and Technology, the Hong Kong Polytechnic University and City Polytechnic of Hong Kong. These organizations have their representatives as members of the sub-committee administering the Centre. There is considerable industry support in the form of donated or specially priced software and hardware.

TESTIMONIALS

Derek Lindsay, Training Manager for the Hong Kong Institution of Engineers (HKIE), has in his professional role been required to assess the value of the EDTCC programs for upgrading and retraining of professional engineers. Following this assessment, he has stated that the EDTCC programs pass professional assessment, and are particularly noteworthy in terms of the,

> *direct relevance to Hong Kong industry with regard to the subject matter ... the excellent course documentation [including the] self-learning approach making the training student-led ... the design and implementation of the assessment schemes.*

In Mr. Lindsay's opinion, "EDTTC is undoubtedly a worthy model for others to follow and HKIE encourages other training centres to do just that."

Mr. C. D. Tam, Senior Vice President & General Manager of Motorola Semiconductors (HK), had this to say about the program at Electronic Design Technology Training Centre,

> *... continuous education with hands-on training using up-to-date equipment is necessary to maintain competitiveness ... The ASIC IC training program organized by the Vocational Training Council has been a successful step in the right direction.*

• *continuous education is necessary to maintain competitiveness ...*

These thoughts are echoed by Mr. S. K. Pun, R & D Manager for VTech Computers.

> *The Electronic Design Technology Training Centre provides practical and useful training ... the courses are useful and applicable to [the engineers'] day-to-day jobs. VTech will fully support and participate in future training courses.*

Professor Joshua Wong, Associate Director (Research & Development) at the Hong Kong Polytechnic University, has said that he feels the success of the EDTTC demonstrates that it is an excellent model for the introduction of other higher technology training.

> *As one of the judges in the Governor's Design Awards, the major design award in Hong Kong, I have come across many new products incorporating locally designed ASIC chips. Also, nowadays, even technician students in Hong Kong are taught ASIC design. Such rapid widespread dissemination of up-to-date electronics technology is doubtlessly due to the work of the Centre. In fact, I see the Centre as a model for speedy introduction of other high technologies. This method is fast, focused and can be tailored to the needs of industry. The Centre works magnificently for Hong Kong. Presumably it can be duplicated elsewhere.*

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Electronics, Metals, Manufacturing, Plastics, Construction & Garment Industries Training

offered by

Hong Kong Productivity Council (HKPC)
HKPC Building
78 Tat Chee Avenue
Kowloon, Hong Kong

THE PROGRAM

The Hong Kong Productivity Council (HKPC) offers several core services to industry. These include: providing consulting services and industry studies; generating information technology solutions to business problems and access to computer services; organizing exhibitions and study missions; and training activities. On request, the HKPC will provide market research, product development expertise, and workforce training - wrapped up in one package. For small and medium size companies, which may not have the resources for new product assessment and development, the HKPC can provide a turnkey package of fully integrated research, development and training.

Hong Kong currently suffers from a labour shortage, brain drain and economic restructuring. Hong Kong employers need more trained staff and upgraded staff, particularly in the areas of general management, technical production and manufacturing. HKPC supports industrial development through its training activities.

Specific packaged training activities offered by HKPC are quite varied and include: electrical and electronics; automation; environmental engineering; metal working; product engineering; computer aided design; printing technology; production management; microcomputer applications; textile production; waste treatment; mould and die making; total quality management; and business, management and supervisory skills. Other training programs are offered, and can be customized to meet the needs of the business or industry contracting with HKPC for product development and training services. HKPC has recently developed a notable reputation for its consultancy and training activities to help clients obtain ISO 9000 series certification.

THE DELIVERY

The method of delivery will vary depending on the specific training activity; however, most include lectures, lab work and application projects. Recently, HKPC developed and has begun offering a distance education package on apparel manufacturing in partnership with Athena Training International Consortium (UK).

Most of the more than 200 HKPC faculty are full-time employees who work as consultants during the day and teach part-time in the evenings, since most of the courses are offered after regular working hours.

• *faculty are full-time employees who work as consultants during the day and teach part-time in the evenings*

SPECIALIZED RESOURCES

HKPC makes use of a wide range of specialized equipment, depending on the particular training program being offered. When training is offered on site, the equipment normally used by the workers or production staff would be integrated into the training activity.

• *equipment normally used by the workers or production staff would be integrated into the training activity*

UNIQUE ELEMENTS AND BENEFITS

The fact that HKPC offers a fully integrated service to clients, coupling product development and training, contributes to its distinctiveness. An example of this approach involved a consortium of five companies that asked HKPC to research and develop a notebook computer, plus train the production staff. In another case, a small manufacturer contracted HKPC to develop the production dies and moulds for a small motor to be sold for use in conveyor operations.

DURATION OF TRAINING

Training programs vary in length, from a few hours to a year or more for some of the certificate and diploma programs. As many as 600 plus training courses are offered each year, attracting more than 14,000 participants.

PARTICIPANTS

In general, no formal prerequisites are required to participate in the training offered by HKPC. Consequently, training participants include craft level trainees through to professional engineers. Examples of companies that regularly use HKPC for training include: Motorola, Chiuhipa Industries, Haking Wong, ASM, and Hong Kong Electric.

ROLE OF PARTNERS

Recently, HKPC has begun working with partners outside of Hong Kong, delivering consulting and training modules. A recent example involved quality management courses delivered to engineering and production managers in P.R.C. Another example is the agreement with the University of Oxford Delegacy of Local Examinations to offer competency-based training programs for local Hong Kong managers. HKPC also enters into strategic alliances with technology suppliers in order to offer comprehensive technology solutions and training to local industry. For example, HKPC recently entered into an agreement with Omron Electronics Asia Limited to form a Technical Integrator partnership to jointly promote a Programmable Logic Controller and related technology.

TESTIMONIALS

Mr. C. L. Wu, Vice President for the Asia-Pacific region of Thermalloy (a client of HKPC's Environmental Management Division), explained his choice of HKPC.

> *We looked at a number of consultancy firms and chose to work with HKPC on this project because we felt that their design was the most reliable. In addition, we have great confidence which has developed from a very close and long standing relationship between our two organizations. We find it very easy to work with HKPC consultants.*

Mr. K. T. Tam, Quality Assurance Manager with Elec & Eltek Co., a leading printed circuit board manufacturer in Hong Kong, thanked HKPC for its consulting role in the ISO 9002 certification program:

> *HKPC had the resources to do the job, and because HKPC was created to promote the development of Hong Kong's industry we were sure it would be committed to our project.*

Another endorsement pertaining to ISO 9000 series certification comes from Mr. Linus Ng, Manager of Shell Hong Kong.

> *HKPC was of great help to LPG [a division of Shell] during the time we spent working on certification. We were able to draw upon its [HKPC's] consultants' in-depth knowledge of the quality requirements for meeting ISO 9000 standards, and the staff was extremely dedicated in working with us to achieve our goals.*

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Simulated Industry Experience for Engineering Students

offered by **Industrial Centre**
The Hong Kong Polytechnic University
Hung Hom, Hong Kong

THE PROGRAM

The Industrial Centre (IC) at the Hong Kong Polytechnic University was founded with the goal of providing simulated industrial environment training as part of the overall education package for engineering students. In 1976, when the Centre was established, this concept was considered to be an educational innovation, combining practical and theoretical training in an industrial environment for engineering students.

The specific objectives of the Centre and this training program include: (1) familiarizing engineering students with common industrial materials, tools, machines and processes covering a wide range of industrial practices; (2) creating a training environment that reflects industrial practices in terms of discipline, working hours, safety practices, and hierarchy; and (3) ensuring that work projects are of an applied nature, incorporating research, product development, prototype production, marketability and technology transfer.

• *engineering students must complete the training program at the IC*

Engineering students at the Hong Kong Polytechnic University, City University of Hong Kong and the Hong Kong University of Science and Technology, who are enroled in undergraduate programs, must complete the training program at the IC. The program consists of a set of training modules tailored to suit the specific engineering stream and meet the needs of local industry. Emphasis is placed on understanding, appreciating and hence valuing the procedures, materials, equipment and processes. While developing craft level skill is not a major aim, this does occur to varying degrees as a byproduct of the project work.

The training program meets the requirements of the United Kingdom Engineering Council on Engineering Applications 1 and 2 (EA1 & EA2), as well as those required by the Hong Kong Institution of Engineers as a training requirement for membership.

THE DELIVERY

• *the IC is organized as a model factory*

The IC is organized as a model factory, complete with work teams that incorporate research, design, prototype creation and production functions. The "factory" has students, technicians and engineers. There is limited formal instruction. For the most part, students are given projects or assignments with associated deadlines, and are expected to complete their work on time. Students who need help are encouraged to ask questions. Most projects require some assistance, and this is used as a check to ensure that learning is taking place. Students often arrive at the IC early,

stay late, and come to the "factory" on weekends in order to "get the job done". For many this is very different than that with which they have become familiar as university students - a fifteen hour work week where the students' primary responsibility is to sit in a lecture hall. The strict deadlines and project assignment approach encourage students to adopt a "meet the customer's needs" mentality.

There are four main areas of specialization in this training program: (1) machining and general engineering; (2) CAD/CAM; (3) material and process technology; and (4) electrical engineering, electronics, and construction.

Throughout the program students are encouraged to pursue the development of their own ideas, and many become quite creative. Ventilated safety helmets, a precision-tooled chess set as a company give away, and a portable vibrometer have been conceived, developed and manufactured by students. In all cases students are required to consider the marketability of products, pricing and cost structures, along with profit potential.

• *students are encouraged to pursue the development of their own ideas*

The program concludes with a six week major project. Students are put into research, design and production teams, with each group having a General Manager, Engineering Manager, Marketing Manager and Quality Control Specialist. Each team designs a product, analyzes the market, develops a production cost and pricing structure, estimates market demand, projects profit/loss, produces a prototype, and makes a presentation of the product and findings to the faculty.

SPECIALIZED RESOURCES

In its 11,000 square metre facility, the IC accommodates a wide variety of general purpose and specialized equipment. Metal cutting processes and general engineering resources include lathes, horizontal milling machines, vertical milling machines, grinding machines, jig boring machines, tool grinders, universal copy milling machines, and precision grinding machines. Non-conventional, precision and fluid power system related equipment includes: electro-discharge machines, wirecut machines, laser cutting machines, coordinate measuring machines, optical comparators, profile projectors, toolmakers' microscopes, laser interferometers, pneumatic training kits, hydraulic training kits, and circuit simulation software.

CAD/CAM equipment includes the following CNC machines: 3-axis milling machines, vertical machining centres, 3-axis turning centres, Swiss type lathes, and a parts programming training system. Additionally, an assortment of workstations and personal computers are complemented by CADDS5, Autocad, Cadkey, Mastercam, Surfcam, Personal Designer, and Personal Machinist.

Material and process technology equipment includes a plastics injection moulding machine, a compression moulding machine, a blow moulding machine and extruder, a CNC turret punch and pressbrake, a heat treatment furnace, hot and cold chamber die casting machines, electro-plating and anodizing facilities, and electric arc, MIG and TIG welding machines. Computer aided software includes C-Flow, Cast-Flow and Cast-Therm.

Electrical engineering and electronics equipment includes a surface mount technology machine, a double-sided PCB design and make facility, and a PCB drilling machine. E-CAD software includes OrCAD and THEDA. Construction equipment includes a pre-stressed concrete unit, a timber mould for RC design and a formwork system.

The IC has the most powerful laser cutting and welding machine in Hong Kong, and has published its own multi-media Computer Aided Instruction (CAI) programs for specialized areas including Electro Discharge Machining Processes.

UNIQUE ELEMENTS AND BENEFITS

• the IC is structured on industrial lines, striving to create a model factory environment

The distinctiveness of this program stems from the fact that the IC is structured on industrial lines, striving to create a model factory environment. The development of the training program has been based on combining the needs of local industry with the requirements for the training of professional engineers and technologists.

Students are given the opportunity to gain a sound and broad understanding of industrial process and procedures. This is followed by a more intense period of specialized training in which they are, as much as possible, exposed to a genuine industrial envionment. Projects reflect real work demands in terms of the end product, production and research requirements, and marketability. Production from student projects is contracted for from within the University and from industry. All projects have a specific and applied end purpose.

Students gain industrial experience by producing tangible results. The training helps them develop skills in innovation, industrial and technical curiosity, as well as technical managerial and decision making.

DURATION OF TRAINING

The typical program is sixteen weeks in duration, and takes place outside of the regular semesters of study in the Engineering Program. For example, students might complete ten weeks of training between first and second year, and then complete the final six weeks of training at the end of the second year. In all program streams the final six weeks constitutes the major project.

PARTICIPANTS

All participants are full-time engineering students pursuing tertiary level education. The programs are modular in structure with considerable flexibility with regards to timing and capacity. The IC can train up to 1,000 students at any one time. More than 3,000 students are trained each year.

ROLE OF PARTNERS

A major goal of the IC, beyond the direct training it offers, is the creation of strong connections with industry. Benefits of these linkages have included a contribution of

CAD/CAM software and hardware worth approximately $4M (US) from Computervision. As result, the IC has become the Authorized Training Centre, providing training to Computervision customers as well as Hong Kong Polytechnic University students. In return, Computervision undertakes the maintenance of the system.

A recent contribution of personal computers by AST has been used to develop and operate a PC based CAD/CAM system as well as a CIM environment.

Consignments of high precision CNC Coordinate Measuring Machines and CNC EDM equipment by Carl Zeiss and Charmilles Technologies respectively has amounted to $5M (US). Again, training programs are provided to faculty and students.

A contribution by LK Machinery of hot chamber die casting machinery has enhanced the IC's facilities in materials joining and forming processes training, and consignment of SMT equipment by Nanco/Dynapurt, including a chip mounter and reflow and screen printing, has provided an opportunity for students to gain hands-on experience with surface mount technology.

The contribution by Allan Bradley of an assortment of motion control equipment including programmable controllers, CNC controller, servo controllers, and servo motors, enables students to better appreciate and understand the application of CNC and servo systems.

The recent donation of a SteroLithography Apparatus from Asia InfoSciences has further provided students with exposure to the latest rapid prototyping and manufacturing technology.

• *industrialists advise on the strategic direction and development of the IC*

Industrialists and representatives from public bodies of different engineering disciplines including electronics, electrical, mechanical and manufacturing advise on the strategic direction and development of the IC through Advisory Committees.

TESTIMONIALS

Support for the work of the Industrial Centre is very strong, and often reflects the applied nature of the trainin_ program. For example, V. C. Davies, Director-General of the Federation of Hong Kong Industries has noted,

> *... the Hong Kong Polytechnic University Industrial Centre has provided valuable training programmes for Hong Kong engineering students to ensure that they have practical experience to back up their knowledge of technical disciplines. In addition, the Centre plays an important role as a research and development facility. ... One only has to look at Hong Kong's efficient labour force to see how this Centre ... has helped to improve the standard of our industrial workforce.*

Mr. Anthony Fung, President of the Institute of Industrial Engineers (Hong Kong), echoed this sentiment, stating that the Industrial Centre has "played a major role in bridging the gap between the academic pursuit and the industrial market needs."

And Mr. Hamish MacLeod, Financial Secretary of the Government of Hong Kong, when discussing challenges faced by Hong Kong in the form of technological change and competition, has stated that the "Industrial Centre provides valuable and essential training and other resources to help local industry face up to that challenge."

A particularly telling testimonial is the interest the IC has received from other countries. For several years the Industrial Centre has been working on joint training with the Colombo Staff Plan College in the Philippines, and following a visit to the Industrial Centre three Australian universities are working to establish their own version of the IC. At South East University in Nanjing, Peoples Republic of China, an IC with a total area of 17,500 m^2 is under construction, and staff from the Hong Kong IC are consulting on the implementation of a similar program at Technikon Witwatersrand Industrial Centre in South Africa. Clearly, the program is a pace setter and an internationally accepted model.

The nature of the IC and its mission are perhaps best captured by D. V. Lindsay, founding Head of the Industrial Centre, when on the occasion of the opening of the Centre's new building quoted Confucius' words,

Is it not a pleasure, having learned something, to try it out at due interval?

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Plastics Training

offered by

Plastics Industry Training Centre
Kowloon Bay Training Centre Complex
2/F., 46 Tai Yip Street
Kowloon Bay, Kowloon
Hong Kong

THE PROGRAM

This program offers four distinct training activities to meet the needs of local employers in the field of plastics.

The first type of training is at the craft level. This program is one year in duration, and trainees receive a certificate upon successful completion. The graduates work in the plastics industry as apprentices. Trainees in this program may specialize in plastic mould making, pattern and model making, or, if they have a somewhat higher level of education on entry, they may study plastics manufacturing engineering.

The second training activity is offered to people who want to change or upgrade their jobs, and who are looking for a way to get into the plastics field. In this program there are two courses: (1) a short program in basic plastics processing and inspection; and (2) a slightly longer program in plastics machine maintenance and settings.

The third training activity is for students from tertiary institutions such as the Chinese University of Hong Kong. These students complete short training programs in plastics processing, materials, moulds, process control and patterns.

The fourth type of instruction is in-service training for participants who are currently working in the plastics industry. These are short courses, tailored to assist plastics professionals to understand and take advantage of changes in the industry.

THE DELIVERY

The training offered at this Centre is for the most part full time, the exception being the in-service training for plastics professionals. All the training activities emphasize the practical skills associated with plastics and mould design, and the Centre operates as a "factory model" whereby trainees are expected to attend and participate according to industrial work habits including industry working hours.

• trainees are expected to attend and participate according to industial work habits

All courses are free of charge, paid for by the government of Hong Kong.

SPECIALIZED RESOURCES

The Plastics Training Centre employs 18 full time instructional staff, all of whom have a rich industry background. They are considered to be technical specialists first and foremost, who model effective and up-to-date technical work practices.

The Centre is equipped with state-of-the-art plastics processing machinery, computer hardware and software in CAD/CAM/CAE technology, and CNC moulding machines. Specific examples include plastics product testing equipment, plastics fabricating and machining equipment, vertical and horizontal milling machines, electro-discharge machines, heat treatment facilities, pantograph machines, injection moulding machines, rotational moulding equipment, extrusion machines, compression moulding equipment, NC robotic devices, automatic product palletisers, hot runner moulding equipment, colour mixers and granulators, electroplating equipment, in-mould decoration equipment, hot stamping equipment, ultrasonic welding equipment, high frequency welding equipment, toy safety evaluation equipment, PLC training equipment and a wide range of computer software for product and mould design, plastics flow simulation, material selection and evaluation, process control, trouble shooting of mould faults, and process data acquisition. This equipment and the associated software is updated continuously.

UNIQUE ELEMENTS AND BENEFITS

• industrial safety habits are built into the program

Unique elements in the Centre's training program include the fact that the Centre uses the same machines as are used in industry. Industrial safety habits are built into the program, as are other industrial practices such as clocking in and clocking out, wearing a uniform, and attending the program five and one-half days per week. There is a flexible format for providing a combination of lectures and practical instruction, but the emphasis is clearly on the practical.

• joint projects with industry and other training institutions are carried out by the Centre in order to provide students with "real life" experiences

Joint projects with industry and other training institutions are carried out by the Centre in order to provide students with "real life" experiences and to keep the training practices current and up-to-date. An example of this type of activity includes recent work the Centre did in partnership with the Hong Kong University of Science and Technology. The University developed a computer program designed to test the setting conditions for moulding machines. The Plastics Training Centre carried out the required tests using this program and provided the data for the University to evaluate and modify the software. Another example occurred when the Centre worked with a manufacturer of polypropylene to evaluate the weld properties of polypropylene rope within certain moulds.

DURATION OF TRAINING

The craft level training is one year in duration, while the retraining programs vary from one to two months in duration. Students from the universities study for one to four weeks, and the programs for practising professionals range from a few hours to several months of part-time day or evening study.

PARTICIPANTS

Craft level students are graduates of forms three through five (grades 9 -12). Approximately 150 of these trainees study at the Centre each year.
Eighty students per year ages 16 to 55 enrol in the retraining program each year. Jobs for these trainees are arranged through a placement centre. The placement rate for those who actively seek jobs is 100%. Participants in this program are paid a training allowance of approximately $80 (U.S.) per month.

The university students typically come from the fields of mechanical, manufacturing, electronics, design and electrical engineering. Approximately 1,000 university students per year participate in this training.

The fourth type of training is in-service training for participants who are working in industry. The Centre offers part-time day and evening courses in such areas as hydraulics and autocad for mould design.

ROLE OF PARTNERS

The Training Centre is managed by a Plastics Industry Training Board comprised of representatives from various plastics associations, tertiary institutions, industrial support organizations, government and trade unions. They provide direction to ensure that the training meets the specific needs of the plastics industry.

TESTIMONIALS

Accolades for the work of the Plastics Training Centre are many. M. Kamiya, Managing Director of Sansyu Precision H.K. Ltd., has stated,

> *Graduates have proved to be very capable technicians. Eighty percent of our technical staff are graduates from your Centre. From their performance, we can see that your Centre offers excellent vocational training facilities – a practical curriculum and well equipped workshops.*

The applied nature of the training is very appealing to employers. Locky K. L. Chu, Executive Director of APAC Industrial Company Ltd., writes,

> *Your comprehensive training activities and simulated factory concept provide a very practical environment for the training of craftsmen and technicians. We consider your graduate trainees as properly trained in all essential technical skills, and well prepared to take up employment.*

Graduates of the Centre's training programs are also highly complimentary. Mr. C. M. Shek, Assistant Engineering Manager of Green Cartridge Company, who started his career as a technician apprentice after his training at the Centre, said, "My career began when I took a course at the Plastics Industry Training Centre." These sentiments are echoed by Mr. P. H. Lam, graduate of the Centre's apprentice training program and now the owner of Choi Hung Moulding Factory. He notes, "What I learned from the Centre I could apply directly in my job."

The effects of the entire training effort at the Centre are nicely summarized by Dennis H. S. Ting, Chairman of Kader Holdings Company Limited in Hong Kong.

> *The Plastics Industry Training Centre has implemented a very comprehensive field of training activities to support the various manpower training and development needs of the local plastics industry. I highly commend the outstanding training facilities of the Centre, as well as the extremely practical nature of the training curriculum. The Centre has not only trained people to take up entry level jobs confidently, it has also provided in-service workers with continuous re-training opportunities to upgrade and expand their skills.*

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Low Cost Automation Program

offered by

Federation of Malaysian Manufacturers
& Festo (M) Private Limited
FMM Entrepreneur & Skills Development Centre
17th Floor, Wisma Sime Darby
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Malaysia

THE PROGRAM

The Federation of Malaysian Manufacturers (FMM) offers a variety of industrial training programs to its members. In collaboration with one of its member companies, Festo (M) Private Limited, FMM delivers a Low Cost Automation (LCA) Program, that is particularly popular with its membership. The LCA Program includes five courses: Introduction to Pneumatics, Introduction to Electro Pneumatic Control, Maintenance of Pneumatic Equipment and Systems, Introduction to Programmable Logic Controllers, and Introduction to Hydraulics.

In the first course, Introduction to Pneumatics, the goal is to provide the participants with a basic knowledge of pneumatics elements and an understanding of fundamental controls and circuits. The syllabus includes characteristics of compressed air, compressed air generation, and the construction of principles of operation and working elements and valves.

In the Introduction to Electro Pneumatic Control course, the goal is to provide participants with a knowledge of electrical components as well as the ability to read, design and construct simple electro-pneumatic controls. The course includes general control engineering, basic electrical technology, basic electro-pneumatic controls, and safety.

The third course, Maintenance of Pneumatic Equipment, focuses on providing participants with a knowledge of components that are subject to wear and possible faults. Elements in this course include function and construction of equipment, reading circuit diagrams, sequence controls, fault identification, and preventive maintenance.

Introduction to Programmable Logic Controllers is the fourth course. It provides participants with a basic knowledge of the construction and operation of PLCs, as well as the ability to write simple programs and operate control systems. Logic functions, processors and memory of PLCs, scanning and sequential programs, timers and counter applications, and peripheral devices are included.

The fifth and final course, Introduction to Hydraulics, provides participants with a basic understanding of the fundamental principles of hydraulics. Physical principles, hydraulic power packs, and the development and practical construction of hydraulic circuits are included.

THE DELIVERY

• *objectives, subject matter and the learning sequence follow guidelines which have been developed and refined from numerous course offerings*

The LCA program is based on solid, time-proven educational principles. Objectives, subject matter and the learning sequence follow guidelines which have been developed and refined from numerous course offerings in the field of control technology.

The program, in its first phase, begins with an overview of the applicable theory. This is followed by a summary of practical applications. Visual emphasis, through the use of boardwork and overhead projectors, is underscored in order to detail control system fundamentals that are related to standards and functions. Audio-visual resources, including videos and transparencies, are used to illustrate various principles of operation and the application of many different technologies. Specialized films are also used. These focus on particular themes, and are used to delve deeper into specific subject areas. Practical demonstrations bring theory to life and help convert the subject matter into concrete knowledge.

In the second phase of the program, the participants are given control problems to solve. These are related to the course content and are firmly rooted in practical applications. Exercise sheets, textbooks, and a special work folder with drawing templates are given to each participant. After each problem has been addressed individually by course participants, the best solution is worked out through a group discussion and then critically assessed.

The last phase involves setting up and testing a drafted circuit diagram on the assembly board. During this exercise the participants are using components currently used in industry. These practical exercises, and the intensive exchange of practical experience between the LCA program participants, turns the learning environment into a lively educational interchange where theory and practical work complement each other.

SPECIALIZED RESOURCES

A mobile laboratory trolley fitted with assembly boards is used in this program. These boards are used to demonstrate various aspects of control technology. When not in use, the components are stored in specially designed compartments.

The components are all arranged on a patented blue assembly board. A specially designed locking system allows fast, safe mounting and removal of components without any tools. All equipment is connected to form operating circuits.

• *this training equipment has achieved international recognition*

This training equipment has achieved international recognition as evidenced by the Gold and Silver Awards from World-Didac, a world-wide organization representing Training Equipment Manufacturers.

UNIQUE ELEMENTS AND BENEFITS

The FMM LCA program is directly tied to the needs of the industry. As an industry association, FMM's purpose is to provide the most direct and relevant training. Feedback from the membership is focused and fast. As a result, curriculum and teaching approaches are continually updated.

The training itself contains a very high proportion of practical exercises within the available time. In this way, the participants are constantly "doing".

The world class training equipment and private sector training partners, along with a highly developed and sophisticated curriculum, also serve to make this program unique. Class size is limited to fifteen participants.

FMM, through its training programs, is actively supporting Malaysia's Vision 2020. Launched in 1991 by the Prime Minister Dato' Seri Dr. Mahathir Mohamad, Vision 2020 is guided by the economic objective of establishing a competitive, dynamic, robust and resilient economy in order for Malaysia to become a fully developed nation by the year 2020.

• *FMM is actively supporting Malaysia's Vision 2020*

DURATION OF TRAINING

The length of the training program is 120 hours. Each course is 24 hours in duration. Participants are not required to complete the 120 hours in one block.

PARTICIPANTS

The course participants are currently employed in manufacturing industries. Their jobs involve designing, operating and maintaining control systems for industrial automation. They must be proficient in the English language and preferably have completed SPM level of education (or equivalent 'O' levels). In the past five years, more than 600 participants have completed the LCA program.

ROLE OF PARTNERS

The FMM works closely with Festo (M) Pte Ltd to design and offer the LCA program to its members. Festo (M) Pte Ltd, in turn, is supported by Festo Didactic, which has been engaged in education and training in control technology for more than twenty-five years. The training equipment, textbooks and trainers are sourced from Festo (M) Pte Ltd, while the FMM undertakes to coordinate and administer the program. The FMM is also responsible for obtaining Approved Training Program status from the Human Resources Development Council which will reimburse up to 80% of course fees.

TESTIMONIALS

Mr. Azman bin Mawasi, Technical Supervisor from Polypak Industries Private Limited, was a participant in the Design in Pneumatic Control course. He described the benefits.

> *[The Pneumatic Control course] is most useful to those who are involved with pneumatic systems. It not only increased my understanding and knowledge, but also enhanced my skills. The practical exercises incorporated in the program were most helpful.*

Mr. Mohammed Mokhtar, Maintenance Fitter from Hicom Freigmate Private Limited, has praised the practical value of the program, arguing that the benefits can be immediately applied. He says, the program "has enabled me to troubleshoot and solve problems which arise at work."

Feedback on the program also comes from Miss Ke'h Chin Choo, Administration and Personnel Manager at Tower Rubber Industries, a company which has sent many of its employees for training in the LCA Program. She notes that,

> *The LCA Programs have certainly achieved the objective of providing my staff with an overview of control technology. The exercises given by the instructors were most valuable to reinforce my staff's understanding of the subject [field of control technology].*

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Petroleum Industry Skills Training

offered by

Institut Latihan Perindustrian Petroleum
(Petroleum Industrial Training Institute)
Mukim Batu Rakit, P.O. Box 138
20710 Kuala Terengganu, Terengganu
Malaysia

THE PROGRAM

Petronas, the national oil company of Malaysia, was incorporated in 1974. This government-owned organization has a total employee complement of almost 12,000. Ranked by Fortune Magazine as number 251 of the world's five hundred largest companies, Petronas has been identified as the fifth most profitable corporation in its industry.

• *this organization has a total employee complement of almost 12,000*

Petronas' Petroleum Industry Skills Training Program, offered at The Institute Latihan Perindustrian Petroleum (ILPP), has four major elements that have been designed to train future employees and to provide current Petronas staff with opportunities to obtain new skills or update existing skills.

The first of these program elements focuses on 18 to 25 year old school leavers. This two year program follows an Apprenticeship Training Model, training participants in specific skills essential for work in the oil, gas and petrochemical fields. Courses in this program include subjects such as mechanical, welding, fitting and sheet metal, machining, plant and machinery maintenance, basic hydraulics and pneumatics, engineering drawing, static equipment, corrosion prevention, refrigeration and air conditioning, crane rigging, and a five day outward bound experience.

The second of the four program elements involves a variety of short courses which are offered to current employees. These courses upgrade employees' skills in technical areas that include instrumentation, electrical, safety, mechanical and supervision. In the fiscal year 1995/96, Petronas will offer more than ninety short courses. Examples include Valve Maintenance and Repairs, Industrial Hydraulics, Advanced Motor Control, Water Treatment and Management, and Basic Industrial Fire Fighting.

Customized Training Courses comprise the third element of the training program. These courses are designed and delivered to suit the highly individualized needs of specific company units and employees. These courses are developed in conjunction with the specific client/employee, and the duration of training is dependant on the training need. One example of a recent customized course was the thirteen week training program in Offshore Operations, which included Process & Instrumentation, Maintenance Management, and Offshore Safety and General Skills. This course was conducted for the Petronas subsidiary, Petronas Carigali Sdn. Bhd. (PCSB).

The fourth element in the training program is the 'Career Ladder Progression Program' that prepares operators and technicians for higher level responsibilities and job positions.

THE DELIVERY

ILPP delivers its many programs through a wide variety of activities. These include lectures, workshop and laboratory practicums, on-the-job-training (OJT), equipment demonstrations, tutorials and focus group discussions.

SPECIALIZED RESOURCES

• *resources reflect the scope and nature of equipment found on the worksite*

The resources that ILPP draws on to facilitate the training programs reflect the scope and nature of equipment found on the worksite. A distributive control system is utilized for the training of the instrumentation staff along with a workshop and laboratory fitted with related equipment. Also, workshops for welding, mechanical, automotive and electrical fields are provided to support the training process. Along with the workshops, laboratories specific to electronics, petrochemicals and communications are also provided by ILPP.

UNIQUE ELEMENTS AND BENEFITS

• *Petronas is, for the most part, self-contained in terms of its ability to provide necessary training expertise for a large workforce*

With its own training programs and training facilities, Petronas is able to ensure a qualified supply of new employees and updating opportunities for current employees without having to rely on external training institutions. In essence, Petronas is, for the most part, self-contained in terms of its ability to provide necessary training expertise for a large workforce.

The Apprenticeship Program ensures that the worker is equipped with the skills essential for safe and productive work prior to joining the petroleum industry. Training of apprentices and others is based specifically on the current and projected needs of the company plants and operations. In this way, at the apprentice level, a trained workforce is treated as an inventory issue, with the trainees graduating and joining Petronas as dictated by company requirements.

The short upgrading courses have been designed following an analysis of job functions related to the petroleum industry. These courses emphasize a hands-on approach, and include major components designed to promote quality consciousness, safety and company loyalty. Because these courses are specific to company needs, the training time is minimized while the practical and Petronas specific applications are maximized.

As noted earlier, the customized programs are tailor-made to reflect the particular and specific needs of a plant or operation, while the Career Ladder Progression Programs are designed to assist employees with long term career path development within the company. As is the case with the short upgrading courses, the customized programs meet Petronas' specific needs. The Career Ladder Progression Programs build morale and help maximize the talents of the workforce.

DURATION OF TRAINING

The two year, full-time apprenticeship training program is the longest training program offered by Petronas. The upgrading courses range from three days to three weeks depending on the particular course.

Customized training courses range from one month to six months, and the Career Ladder Progression Program courses average five days in length.

PARTICIPANTS

Between 200 and 250 apprentices are enroled each year into the full-time program of apprenticeship training. The minimum entry requirement is a certificate from SPM/SPVM (equivalent to "O" level education).

Short courses are attended by technicians, operators and new engineers. Approximately 450 employees attend short courses each year.

The upgrading and Career Ladder Progression Programs are delivered on a full-time basis to a class size of approximately twelve people. No specific educational prerequisites are required for these courses.

Customized training programs have no specific prerequisites and the number of trainees is related to the clients' needs and the availability of facilities. Safety and team building courses, for example, are offered over a three to ten day period with class sizes averaging twenty participants.

ROLE OF PARTNERS

In addition to providing training at the Petronas plants, including on-the-job-training for the apprentices, ILPP also delivers training at other institutions, including the Institute Sultan Ahmad Shah for boiler certification, Jabatan Bekalan Eletrik for the Chargeman Certificate and the National Vocational Training Council for trades training in Machining, Welding and Fitting.

Beyond the established ILPP training programs and services, ILPP also provides a range of technical and advisory services to other institutions. Examples have included developing an integrated oil and gas curriculum for Kuching Polytechnic, providing equipment and instructors to IKMs for advanced Welding training, and developing curriculum for the gas pipe fitters coordinated by NVTC. ILPP's experience in training for the petroleum industry has made its expertise and training materials highly sought after by other institutions both within and outside of Malaysia.

• ILPP's experience has made its expertise and training materials highly sought after by other institutions

TESTIMONIALS

Jean F. Theelen, of Amoco Chemical (Malaysia) Sdn. Bhd., has described many of the features of the ILPP Program, and feels the benefits for Amoco are significant.

The ILPP apprenticeship program is a vital part of the recruitment and training of the Amoco Chemical (M) Sdn. Bhd. Purified Terephthalic Acid (PTA) plant at the Gebeng Industrial Estate, Kuantan. This grassroots facility, the first for Amoco in Malaysia, requires 300 professionals and highly skilled technicians. An estimated training of 300 man years will be required, of which about 150 man years will be provided through the 86 apprentices of ILPP. As such ILPP provides about half of all training needs of AC(M).

The excellent features of the Petronas Training are as follows: high standards for selection, drawing excellent candidates from every part of Malaysia; curriculum for Oil and Gas industries is identical to the needs of the Petrochemical industry, and it is very good; the structure of the two year program is ideal for a grassroots plant, a good combination of classroom and on-the-job training; the infrastructure of the training institute is very good; the number of skills offered covers perhaps 90% of all skills needed for a chemical plant; a professional and dedicated instructional staff; the Honeywell TCD 3000 simulator; fast decision making, excellent working relations, and flexibility on skills selection.

In a similar fashion, Mr. Abas Samat, from the Training & Development Department at Tioxide (Malaysia) Sdn. Bhd., said,

Prior to construction of our plant, we sent eleven apprentices to ILPP for a two year program. The theoretical and practical knowledge they gained during their training proved to be very useful during the construction and commissioning of our plant.

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Utility Engineering Training

offered by

Utility Engineering Training Division (ILSAS)
Institut Kejuruteraan Teknologi Tenaga Nasional (IKATAN)
Jalan Serdang, 43009, Kajang
Malaysia

THE PROGRAM

Tenaga Nasional Berhad (TNB) is the largest electric utility company in Malaysia. It generates and distributes electricity in peninsular Malaysia, and is the largest Malaysian company listed on the Kuala Lumpur stock exchange. Institut Latihan Sultan Ahma Shah (ILSAS) was originally established by TNB to serve the needs of TNB employees, present and future, in utility engineering training and utility management training. Building on its success, it was expanded in 1994 to become Institut Kejuruteraan Teknologi Tenaga Nasional (IKATAN) to provide higher education training opportunities for TNB employees as well as other students. ILSAS is now the utility engineering division of IKATAN.

The Institute was first conceived in the early 1960s, at which time the United Nations Development Program (UNDP) provided planning, design, and operational assistance. The International Labour Organization (ILO) was appointed executing agency and construction, which was started in 1976, was completed in 1982 at a total cost of Malaysian Ringgit RM 70 million. Since then, an additional RM 30 million has been invested in the purchase of additional and upgraded training equipment. In 1994 a budget of RM 200 million was approved by the Board of Directors for a new complex designed to meet the future demand for training. The Institute is a regional centre of training excellence for technical training and manpower development in the public utility (electrical) field.

• *the Institute is a regional centre of training excellence*

Training programs specific to the utility field include a multi-skill vocational training program, short utility training engineering courses, and undergraduate degree programs in electrical and mechanical engineering. The latter programs are offered in cooperation with Indiana University-Purdue and the University of Indianapolis.

The vocational training program is designed for and delivered to Malaysian youths who have a minimum of nine years of schooling. The training program includes mechanical, electrical, electronic and instrumentation. Emphasis is given to the mechanical skills because Tenaga National's training needs analysis indicates that this is the area of greatest demand for employment in local industries. The program is funded by the Tenaga Nasional Foundation, a trust that was established to fund training and education for the public as well as other charitable activities.

• *the short courses offered by IKATAN number upwards of three hundred*

The short courses offered by IKATAN number upwards of three hundred. These are mainly in the energy sectors, focusing on power generation, transmission and distri-

bution. Although these courses have been designed for and have been primarily offered to TNB employees, non-TNB participants attend on an increasing scale.

In August 1994, the Institute was licensed by the Ministry of Human Resources of the Malaysian Government as an Approved Training Provider to provide training for the Malaysian workforce. In part, this reflects IKATAN's reputation for technical educational expertise in the energy sector, the vast array of energy sector courses that are offered, and the quality of training materials and the training facility. Courses typically last for one to two weeks, but some are conducted for more than one month, particularly if they are related to career advancement requirements.

Undergraduate science degree programs lead to the Bachelor of Electrical/Mechanical Engineering (BEE/M). Offered in cooperation with Indiana University-Purdue and the University of Indianapolis, there are two intakes each year. The first two years of the program are completed at IKATAN, and the final two years in Indianapolis.

For management staff, postgraduate degrees in management are offered through twinning arrangements with the University Malaya (Executive Master of Business Administration) and Ohio University (Corporate Master of Business Administration).

THE DELIVERY

• technical and vocational trainees are exposed to a real-world working environment

At IKATAN, importance is placed on hands-on training. Wherever practical, technical and vocational trainees are exposed to a real-world working environment. Of necessity, equipment used in this training is the same as that used on the job, and IKATAN has invested heavily in the necessary facilities and equipment.

All trainees are provided with lecture notes and textbooks. Video, audio and industrial visits are also used in the training programs. For those trainees who are coming from the world of work, it is expected that they will share their experience as part of the learning process. In this way, real issues are brought into the classroom, then shared, examined, evaluated and resolved. Depending on the client base, programs are conducted in either English or Malay. All courses can be delivered in either language.

SPECIALIZED RESOURCES

• the hands-on approach to training has required a substantial investment in specialized equipment

The hands-on approach to training has required a substantial investment in specialized equipment. Examples of this equipment include the following: PLC - Mudicon and Omron; Distributed Control System – Bailey Network 90 for boiler control system, boiler simulation and operator stations; physical plant simulator - water circuit for steam boiler; computer labs; advanced electronic lab with digital trainer, microprocessor trainer and power electronics trainer; 11 kV simulator for fault analysis, switching procedure and cable fault location; power system protection lab; domestic and industrial wiring lab; 11 kV distribution testing equipment; live line lab; simulated electric transmission tower - extra high voltage/high voltage; simulated low and medium voltage overhead line; telemetering for remote meters - software and hardware; 120 and 300 Mw fossil-fuel power plant simulators; low voltage genera-

tor synchroniser; electrical transmission system simulator; non destructive test equipment and auxiliaries for ultrasonic, radiographic, magnetic particles, dye penetrant and eddy current testing; vibration monitoring equipment, laser alignment; Deutz diesel engine; 25 Mw gas turbine model; and 1.7 Mw steam turbine.

In addition to the technical resources, IKATAN maintains a 777 bed hostel for trainees and dining hall that seats 1,000.

UNIQUE ELEMENTS AND BENEFITS

The distinctive characteristics of the training program include its size, the comprehensive facilities and training equipment, the many linkages that have been developed by IKATAN, the variety of programming, and the experience level of the trainers.

These characteristics, when combined, have made IKATAN an attractive regional resource. Although still growing and developing in order to meet the needs of Malaysia, IKATAN is increasingly called upon to share its expertise regionally and abroad.

• IKATAN is increasingly called upon to share its expertise regionally and abroad

DURATION OF TRAINING

Training varies from one week for short courses through to seven months for the vocational training and four years for the undergraduate degree programs.

PARTICIPANTS

The number of trainees for most courses ranges from twelve to twenty-four. In some courses, the nature of the training dictates smaller groups, and it is not uncommon to see as few as six to eight participants.

The participants vary from grade nine school leavers in the vocational training program, to senior managers in some of the highly technical short courses. In 1992/93, approximately half the staff were executive/management and half were non-executive/technical. In that same year, the training investment was split 27% management and 73% technical. In 1993, ILSAS trained more than 3,500 personnel.

ROLE OF PARTNERS

IKATAN works with a vast network of public and private sector partners, nationally and internationally. For example, over the past decade Malaysia's National University, or University Kebangsaan Malaysia, has been using IKATAN's mechanical workshops, other facilities, and trainers for first and second year university students. IKATAN has conducted electrical competency courses for off-shore technical platform workers from ESSO, and the World Bank has funded training at IKATAN for staff from the Ceylon Electricity Board and staff from Electricité du Laos.

TESTIMONIALS

Budi S. Sudarsono, Officer-in-Charge from the United Nations' Economic and Social Commission for Asia and the Pacific (ESCAP), has described the Regional Energy Development training programs offered to ESCAP staff by ILSAS as very successful.

> *I wish to express my sincere thanks and gratitude to you and your colleagues for your kind assistance in organizing the course. The excellent preparations, good facilities and warm hospitality extended to the participants, the resource persons and the ESCAP representatives are greatly appreciated by ESCAP. Sincere efforts made by you and your colleagues played a key role in the success of this course.*

Carolyn S. Tager, Senior Operations Officer with the World Bank's Asia Alternative Energy Unit, argues that IKATAN's know-how positions it nicely as a regional training centre.

> *The successful implementation of the Tenaga/EDL [Electricité du Laos] program offers the potential for similar arrangements with utilities elsewhere. Tenaga's excellent training facilities and program strengthen its position as a regional training entity for this purpose.*

The Asian and Pacific Development Centre uses IKATAN as a model for training efficiency and expertise. K. V. Ramani, Executive Secretary for APENPLAN, notes,

> *... the Asian and Pacific Development Centre (APDC) and the Asian and Pacific Energy-Environment Planning Network (APENPLAN) will be implementing a three week training course for 20 senior officials from the Ministry of Energy, Vietnam ... In addition to the formal lecture/workshop sessions, the group would also find it extremely useful to visit an actual training centre for practical exposure. ... the Sultan Ahmad Shah Training Institute would be of direct relevance as it deals with training of manpower for the country's energy sector.*

Finally, V. Kanthasamy, Additional General Manager (Human Resources) of the Ceylon Electricity Board, has described the overall evaluation of the training received by Sri Lankan CEB staff.

> *I am very happy to inform you that the Ceylon Electricity Board is very satisfied with the training given to various officers of the Ceylon Electricity Board by ILSAS. ... I also wish to recommend your Institution to any institution which would like to take training ...*

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Engineering & Technical Diplomas

offered by

Workers Institute of Technology (WIT)
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THE PROGRAM

The Workers Institute of Technology (WIT) is one of the largest private technical colleges for human resource development in Malaysia. Its main objective is to provide school leavers and unemployed youths with an opportunity to acquire technical training that will enable them to earn a living. Established in 1977, WIT has contributed to Malaysian human resource development through educating and training more than six thousand technical graduates who are actively participating in Malaysia's industrial growth.

• *WIT is one of the largest private technical colleges for human resource development in Malaysia*

WIT is the brainchild of the Malaysian Transport Workers Union (TWU). The initial purchase of land and the construction of WIT was made possible through contributions from thousands of ordinary workers in Malaysia, including taxi drivers, lorry drivers, bus conductors and rubber tappers. Support was also received from the Malaysian Trade Workers Congress, the International Confederation of Free Trade Unions, and the Asian American Free Labour Institute.

WIT offers thhee-year full and part-time technical diploma programs in Electrical/Electronic Engineering, Mechanical Engineering, Automobile Engineering, and Computer Science. Along with the Diploma programs, WIT offers two-year full- and part-time certificate courses in General Mechanics, General Machinist, Electrical, Industrial Electronics and Automobile Mechanics.

THE DELIVERY

Diploma students spend sixty percent of their time studying theory related to core technical subjects. The balance of their study time is spent working on practical applications. The certificate students spend eighty percent of their study time in practical settings, where they acquire job related skills, and the balance of their time studying related theory and core subjects.

The Certificate courses offered at WIT follow the syllabus developed by the National Vocational Training Council (NVTC); therefore, students who successfully complete their training are eligible to write the NVTC trades test. Students who subsequently pass NVTC's tests are awarded a National Skill Certificate. This is the enabling document that permits graduates to work in the field.

SPECIALIZED RESOURCES

WIT has forty-eight lecture rooms and a host of laboratories including an electronics lab, a digital lab, a power lab, a pneumatic and hydraulics lab, a machining workshop, a welding workshop, a computer lab, and an architectural studio. Equipment needs are reviewed and addressed annually.

WIT employs more than one hundred faculty, all of whom are qualified in their respective fields. WIT places special emphasis on ensuring that all faculty participate in short courses and seminars in order to stay current in their disciplines.

The modern library is furnished with a vast range of technical reference books, newspapers and magazines.

UNIQUE ELEMENTS AND BENEFITS

• built by trade unionists, WIT is an example of what workers can achieve

The WIT Training College was developed, built, and is supported by trade unionists. As such, the fundamental approach and rationale underlying the institution is unique. WIT is an example of and speaks directly to what workers, united in a cause, can achieve in support of their beliefs.

To this day, the links that WIT has with Malaysian and international trade union organizations are critical for the support and success of the Training Institute. Financial assistance has been received from the National & International Trade Unions, the Asian American Free Labour Institute, and the Japan Institute of Labour.

DURATION OF TRAINING

The Engineering Diploma Courses are delivered over a three year period while the Certificate Courses are delivered over a two year period.

PARTICIPANTS

Minimum entrance requirement for the Engineering Diploma Courses is a pass at the SPM level (equivalent to 'O' levels). The certificate courses require a pass in the lower Secondary level. The average age for diploma holders is seventeen, while the average age at the certificate level is fifteen.

The Engineering Diploma Programs currently have 1,095 students attending on a full-time basis and 117 students attending on a part-time basis. Certificate courses have 610 students attending full-time and 415 students attending part-time.

ROLE OF PARTNERS

As a non-profit technical training institute, WIT has received development aid from a variety of different sources including the International Confederation of Free Trade Unions, Bosch Company and the German Government.

WIT currently provides basic skills training to a group of selected employees of Malaysian Airlines (MAS) who will eventually become aircraft engineers. This training was designed through a collaborative process with MAS and WIT representatives.

WIT Certificate courses are approved by NVTC and the Human Resources Development Council (HRDC), Malaysia. Employers who are members of HRDC can claim up to 80% of the course fees for the training of their employees at WIT.

Engineering students at WIT are eligible for advanced standing in eighteen institutions of higher education in the United Kingdom and three in Australia.

The University of Sunderland offers two partial scholarships annually to WIT diploma holders who wish to pursue engineering degrees. Further, the University of East London, Oxford Brookes University, University of Hertfordshire and University College London offer partial scholarships to WIT graduates who wish to pursue engineering degrees.

TESTIMONIALS

Mohd Shah Khalid, Training Manager for Malaysian Airlines, speaks very positively about the WIT programs.

> *The Engineering Division of Malaysia Airlines Systems (MAS) has collaborated with the Workers Institute of Technology (WIT) in Port Klan for the past four years. The training provided by WIT has become one of the requirements by the Civil Aviation Authority for our apprentices to gain their aircraft maintenance engineer license. MAS is happy with the level of instruction and practical exposure in co-curricular activities that are available to our students in WIT.*

Nestle Foods has a close affiliation with WIT, and P. Viswanathan, the Training Facilitation Manager, is very supportive of this relationship.

> *Nestle Foods (M) Sdn Bhd has been closely associated with the Workers Institute of Technology for the past 11 years. During this period we have used WIT's expertise to conduct skill upgrading courses for our technical personnel ... We are indeed very happy and proud to be associated with the Institute because of their dedication and commitment towards Human Resource Development in Malaysia.*

It can be argued that the most important measure of an institution's worth is the impressions that graduates have of the value of their training. If this is the case, the words of Joseph Thomas, WIT graduate, speak volumes.

> *As a [WIT] student, I witnessed the sheer dedication and enthusiasm among the lecturers and instructors at WIT and, coupled with the facilities available, I received very good training. In 1990 I applied to the University of Sunderland, United Kingdom, to complete a B. Eng. in Design Engineering. With the recommendation of WIT I received a partial scholarship from the*

University. I completed my B. Eng. course in two years because I was exempted from the first two years of the course for having completed my diploma course at WIT. Currently I am employed by ABB Power Generation Sdn. Bhd. as a Design Engineer and I attribute my career success to the initial education and training I received at WIT. Thank you WIT.

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Mechanical and Production Engineering

Manufacturing Simulation Project - Virtual Factory

offered by **Department of Mechanical and Production Engineering**
Private Bag 92-006
Auckland Institute of Technology (AIT)
Auckland, New Zealand

THE PROGRAM

The Department of Mechanical and Production Engineering at the Auckland Institute of Technology (AIT) has long recognized that the role and nature of the Engineering Technologist is changing. These changes have been accelerating with the increased use and interfacing of computers and computer technology in the engineering environment. Recognizing the need to adapt to this change, the department recently restructured its program. Major changes include an extension of the program from a two year program to a three year diploma in Engineering and the use of the Virtual Factory as the core teaching tool.

With extensive use of computers and computer-assisted equipment it was next to impossible to cover the breadth and depth of the material necessary to prepare students in two years for the challenges they would encounter in modern industry. Thus, a 50% increase in the length of the program (one year) was initiated for the diploma program. This change is consistent with programs in other countries, especially Canada, where many of the engineering technology programs are three years in duration. In addition to broadening the time frame and depth of certain subjects, the concept of the Virtual Factory was added to the curriculum.

• *the Virtual Factory integrates the theory, design, application and point-of-action in a user-friendly, realistic, instructional environment*

The Virtual Factory is a computer-based, student environment that integrates the theory, design, application and point-of-action in a user-friendly, realistic, instructional environment. This allows teaching and learning to take place in a setting that interfaces the various components of a Computer Integrated Manufacturing (CIM) system.

This system combines computer aided design and manufacturing (CAD/CAM) information with production engineering and business management software. State-of-the-art industrial software is linked with an interactive simulation of a 'model factory'. Students can visit different sections of the factory to view and understand the information flows within it. In this way the system allows students to control the computer driven relationships that exist between the various stages of product concept, design, production planning and manufacturing in a modern engineering organization. By placing the student in a simulated factory environment, the impact of activities among departments becomes immediately apparent. The governing con-

• *students control the computer driven relationships that exist between the various stages of product concept, design, production planning and manufacturing*

cepts of engineering management, production engineering and product design are then graphically illustrated. As a result, the students learn in an interactive system at a level appropriate for their abilities.

Creating an educational platform with a strong industrial perspective is the key objective of this program. It is founded on concurrent engineering and design ideologies. The overall aim is to produce engineering graduates with a fundamental understanding of Flexible Manufacturing Systems (FMS), Computer Integrated Manufacturing (CIM), and Manufacturing Resources Planning (MRP).

THE DELIVERY

The Virtual Factory is a Microsoft Windows system developed in Microsoft Visual C++. In this system, students are exposed to the Virtual Factory in three major phases. The first phase is called the initial educational environment. In it, students are provided with an overview of the network, which is accessible from the AIT computer network. The relationships and data sharing among the various departments are graphically illustrated, and students can design product components and assign factory floor equipment to aid in the manufacturing process.

Phase 2 is the scenario builder. In this phase students create different production scenarios, and then test the system under the operational constraints. Simulated output is used to analyze the system and find solutions to scheduling and production problems.

The third phase provides industrial tools access. At this stage, students access computer application tools and work with full versions of the program while maintaining a link to the factory environment.

The phases are applied to four areas within the manufacturing environment: product design, production engineering and inventory control, CNC machine operation and control, and engineering management.

• *students gain a holistic view of how the organization functions*

As students visit each area within the 'factory' they are introduced to various computer-based tools. These relate to the functions carried out by employees within those areas. This enables students to gain a holistic view of how the organization functions, including where, how and why information flows through the system. Each section within the factory comes complete with fully interactive help that explains in detail functions and responsibilities that are pertinent to that area.

Specific Virtual Factory course modules include computer-based production and inventory control and simulation of manufacturing systems. Other course modules in the diploma program are lecture-based with laboratory and industrial site work. The Virtual Factory is expected to be a major supplement to the laboratory work in these courses.

SPECIALIZED RESOURCES

AIT has long been a premier centre for Computer Aided Drafting and Design training. AIT became New Zealand's first Authorized AutoCad training centre in 1987 and is one of the largest training centres in Australasia for CAD.

The Mechanical and Production Engineering Department at AIT has a 700m² quality computer applications centre situated just off campus in central Auckland city. The centre has four classrooms currently equipped with 60 PCs (486DX2 processors with 16 Mb RAM).

Although a substantial amount of CAD training is carried out by AIT, the computer applications centre, together with AIT's expansive engineering workshops and CNC unit, offers a wide range of CAE/CAM/CNC programs. The Virtual Factory links these programs together and supplies students with a comprehensive understanding of their applications as a whole.

UNIQUE ELEMENTS AND BENEFITS

The Virtual Factory is the primary, unique element in this program. In the context of this application, the process of product design, systems control and control for production and manufacturing is interactive, dynamic and interrelated. Other teaching methodologies in this field have simply exposed students to discrete problem-solving tools within each field. A global view of how each sub-process combines to form a functional and self-sustaining whole has been difficult to teach. This project breaches this barrier by utilizing computer technology and simulation systems.

In the past, engineering students have been given solid experience in the use of space and materials, but relatively little training in the critical dimension of time. This is because students can't actually run a factory. With this software students are given the ability to control the production and scheduling of a manufacturing facility without the associated risks.

• *students are given the ability to control the production and scheduling of a manufacturing facility*

Within the simulated environment, the student manufacturing manager is challenged by late deliveries of raw materials, breakdowns of machinery and even sick employees. Students can create "what if" solutions to scheduling and production problems, and can analyze the performance of those suggested solutions.

This combination of business database management with CAD/CAM and computer simulation provides AIT with a unique teaching resource.

DURATION OF TRAINING

The diploma program is three years in duration. Virtual Factory course modules require twenty hours of teacher-led instruction per module with additional project time for students on an individual basis.

PARTICIPANTS

All participants are high school graduates, eligible to enter the AIT diploma programs.

ROLE OF PARTNERS

The Wolf-Fisher Trust, a major provider of grants for the development of technology in New Zealand, has donated NZ$30,000 to aid in the development of the Virtual Factory project. A previous donation from the same trust amounted to NZ$100,000. This was used to purchase much of the hardware and software for the computer applications centre.

Other industrial support has come from Fisher and Paykel, New Zealand's leading manufacturer of whiteware products, who have donated in-house developed industrial control hardware and software.

In addition, the program was awarded a NZ$20,000 research grant from the Institute itself to aid in the development of the project.

TESTIMONIALS

Professor Des Tedford of the Mechanical Engineering Department at the University of Auckland, describes why this project is important.

> *This project should be ranked as a top priority. The integration of engineering, manufacturing and production is the number one problem tackled by industry today. This project will equip students to meet the needs of industry. There is also a potential to reduce teaching workload and improve quality by being able to reach a wider range of student capabilities with fewer contact hours.*

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Engineering Technology - University Linkage

offered by

College of Industrial Technology (CIT)
Technological University of Philippines
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Philippines

THE PROGRAM

The College of Industrial Technology (CIT) training programs at the Technological University of the Philippines (TUP) are designed to train high school graduates in a range of industrial technical fields including civil, electrical, electronics, communications, instrumentation, automotive, marine, refrigeration & air conditioning, tool and die, fashion, printing & food technology. Five of the six semesters in this program involve school-based instruction and one semester is industry-based. This training serves as the entry requirement for the degree programs at the university level.

A fifty-four hour Industrial Orientation Program (IOP) is integrated into the first year of study in order to guide the students prior to their final selection of the major course of specialization. Through plant visits and symposia, where field experts act as resource speakers, the IOP is the means by which the students are provided with the necessary information regarding job competency requirements and job opportunities in order to make informed career decisions.

THE DELIVERY

Program delivery includes lectures augmented with video presentations, labs and experiments, demonstrations, and on-the-job training (OJT).

On-the-job training is an eighteen week component of the program. During this element of the program, students are attached to industry for supervised technical training. They receive eight hours of instruction per day for ninety instructional days or a total of 720 hours of OJT.

• *students are attached to industry for supervised technical training*

There are almost ninety faculty in the College. Approximately one quarter of them are engineers, and the rest are Bachelor of Education in Industrial Science graduates. More than 80% of the faculty have received training outside the Philippines, most often in Germany, Japan, Australia, the Netherlands and India.

SPECIALIZED RESOURCES

Aside from the basic tools and equipment used in the different areas of industrial technology training, the Integrated Research and Training Centre (IRTC) at the University, with its state of the art equipment and facilities, provides additional practical training. It is both a highly specialized resource and a unique element of CIT and TUP programming.

The IRTC was established by the Japanese International Cooperation Agency (JICA) in 1982 as the national centre for engineering research and training. It is accredited as a national testing centre by the Department of Public Works and Highways.

UNIQUE ELEMENTS AND BENEFITS

• *a graduate can pursue any of the technical degrees offered by the University*

The program has a heavy emphasis on science and technology. The result is that students gain the necessary requirements for entry into degree programs. A graduate of the CIT program can pursue any of the technical degrees offered by the University, with all the units earned in the CIT program credited towards bachelor degrees such as the Bachelor of Engineering, Bachelor of Technology and Bachelor of Technician Teacher Education.

DURATION OF TRAINING

The CIT technology programs are three years in duration. During the first five semesters, students take part in theory and practicum training on the campus. During the sixth semester, they are attached to an industry for eighteen weeks. An above average performance rating for their industrial placement as graded by an industrial supervisor is a requirement for graduating from the program.

PARTICIPANTS

CIT enrols approximately 1,400 day students and 1,200 part-time evening students. The pre-requisite for admission to the program is a high school diploma and a passing grade on the University admission test.

More than 85% of the students are male. Female students tend to be enroled in food technology and fashion design, with only a few in electronics, communication and instrumentation. Most students are eighteen to twenty-one years of age, and about 20% of them continue into the degree programs.

ROLE OF PARTNERS

There are more than two hundred active cooperating industries involved in the implementation of CIT's 720 hours of supervised industrial training. The eighteen week industrial immersion of the students, as provided by medium and large scale industries in Metro Manila and neighbouring provinces, provides the necessary exposure of the students to industrial practice.

• *companies sponsor scholarships for particularly promising or needy students*

As well as serving as partners in training, cooperating companies also donate equipment and sponsor scholarships for particularly promising or needy students. Examples of cooperating partners include Philippine Daichi Inc., Toyota Motor Philippine Corp., OHM Electronics Philippines Inc., Micromatic Industries Inc., Philippines Airlines, MOOG Controls Corp., National Power Corporation, Reynolds Philippines Corp., and Texas Instruments Philippines.

Designated as a Toyota Technology Centre, the College has recently received training and tools valued at $1.2M Pesos from Toyota Motors Philippines.

In the current school year, there are almost 300 hundred students receiving scholarships. More than one hundred of these were sponsored by non-government organizations such as the Coca-Cola Bottlers Philippines Foundation and the Kingpaoguat Typoco Tanyu International Foundation Inc.

TESTIMONIALS

Mr. Henry M. Muhi, Senior Manager of Philippine Daichi, Inc., directs a firm that manufactures plastic moulds and dies. He is a strong supporter of CIT's program.

> *We believe that CIT and TUP graduates ... possess the necessary competencies needed in our [company]. Presently we have fourteen employees who are graduates... We hope that we will continue to be partners [with CIT and TUP] as we pursue our corporate goal of being the No. 1 firm in plastics engineering and the realization of Philippines 2000.*

Mr. June Lauro, Supervisor of Recruitment and Training for Toyota Motors Philippines Corporation, has described this program as a training ground for "a new breed of workers, innovative, high spirited and equipped with the necessary basic technical training that allows them to blend into the Toyota culture."

Mr. Edgar P. De Jesus, Personnel & General Affairs Manager at ROHM Electronics Philippines Inc., has said,

> *... our company prefers graduates of [CIT & TUP] over other technical schools ..the quality of graduates meets the work standards of multinational companies ... [the] curriculum offered by the institution [meets] industry requirements, [and] graduates absorbed by our company have proven to be very competent with little additional training time.*

Finally, Mr. Eugenio J. Vinta, President of Micromatic Industries Inc., prefers to hire graduates of CIT and TUP "over other schools because they are hardworking, technically competent, and willing to undergo re-training for future advancement in life."

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Industrial Training Program in CAD/CAM
Technician Education

offered by

Colombo Plan Staff College for Technician Education
Building Block C, University of Life Complex
P.O. Box 7500, Domestic Airport Post Office
Pasay City 1300, Metro Manila
Philippines

THE PROGRAM

The Colombo Plan Staff College for Technician Education (CPSC) is an intergovernmental development organization formed more than twenty years ago to enhance the quality and the relevance of technical and vocational education (TVE) in nineteen Colombo Plan member countries in the Asia-Pacific region. The countries include Australia, Fiji, India, Indonesia, Japan, Republic of Korea, Malaysia, Papua New Guinea, Philippines, Singapore, Sri Lanka and Thailand. CPSC is hosted by the Government of the Philippines and is located in Manila. CPSC implements partnership programs in member country institutions with the support of a variety of international development agencies. CPSC occupies a unique position in Asia and the Pacific as it is the only regional organization that provides leadership in addressing issues in TVE through the planning and implementation of human resource development programs in training, research and development, information dissemination and consultancy. To maximize the utilization of resources and share the expertise of member countries and key TVE institutions and development agencies, CPSC carries out these programs through partnerships and collaboration with other key institutions in the region.

• *all CPSC programs are tailor-made to suit the specific needs of the participants*

To accomplish its mission, provide a proactive sustainable impact in its member countries, and strengthen linkages among institutions in developed and developing countries, CPSC develops programs that respond to the increasing demands of industrial technology training. All CPSC programs are tailor-made to suit the specific needs of the participants. One such program is the Industrial Training Program in Computer Aided Design and Computer Aided Manufacturing (CAD/CAM). In many respects, this program is illustrative of the type of industrial technology training programs carried out by CPSC.

The use of CAD/CAM in industries is becoming more widespread in many developing countries because it directly affects productivity, thereby increasing competitive capability in international markets. Thus, the demand for CAD/CAM operators and technicians is on the rise, making CAD/CAM an essential element in technician education. With the industrial boom, the education systems in developing countries have been unable to meet the labour needs of industries for skilled technicians.

CPSC embarked on a training program that would help technician education institutions cope with the increasing demands for CAD/CAM technology. Using the multiplier effect, the program trains core trainers and instructors who are expected to train other technicians in CAD/CAM.

To date, CPSC has conducted three Industrial training Programs in CAD/CAM. These were sponsored by the Commonwealth Industrial Training and Experience Program (CITEP) of the Fellowships and Training Program (FTP) of the Commonwealth Fund for Technical Cooperation. Collaboration with the Industrial Centre of the Hong Kong Polytechnic University (IC-HKPU) was a key element in this program. A total of seventy-six engineers, lecturers, instructors, and trainers of key institutions have completed the training program.

After the first program in 1990, a set of CAD/CAM training modules was developed by CPSC with technical assistance from CFTC and IC-HKPU. The modules are available for use in member countries.

CPSC is scheduled to conduct the next CAD/CAM training program in cooperation with Temasek Polytechnic (Singapore). These partnership arrangements enable CPSC to draw upon regional resources.

THE DELIVERY

The CAD/CAM Training Programs are conducted by expert engineers with extensive practical and theoretical experience. Sessions are composed of 30% lecture and 70% hands-on practice and demonstration sessions. In the first class session, the faculty assess individual trainee capabilities by reviewing curriculum vitae and facilitating an open question and answer period. In this way, the faculty are better able to modify course presentations to meet the specific needs of the trainee group.

All lecture sessions are immediately followed by hands-on exercises and participative demonstrations. Individual and group practical assignments are also given in order to ensure concepts are immediately applied by the trainees. A host of related issues, including maintenance and installation, personnel selection and training, and administrative systems, are discussed. This facilitates the process of institution building in the participating countries. Aside from training sessions, there are shop floor demonstrations of CAD/CAM facilities by major suppliers, as well as field visits to factories and production centres where CAD/CAM is extensively used.

• all lecture sessions are immediately followed by hands-on exercises and participative demonstrations

The program is divided into several components including CAD, CNC machine part programming, CAM, CNC machining, and CAD/CAM project demonstrations/presentations. Sessions are progressive and developmental with topics that range from simple configurations and designs through to complex 2D and 3D wireframes and assembly drawings. From the first week onwards, the participants work on building a model project. In order to produce the model, the participants conceptualize, design, draw, create tool paths, transfer geometrical data from CAD to CAM and access ISO and interactive programming languages for 3-axis CNC milling machines. The faculty and invited experts from industry evaluate and assess the models, which include explanations of the processes involved in produc-

tion as well as the problems encountered during the preparation and production of the prototype.

SPECIALIZED RESOURCES

To run the training program, CPSC uses the resources and expertise of CAD/CAM training institutions in the region which have active collaboration with industries. As noted earlier, this includes the Industrial Centre at the Hong Kong Polytechnic University and Temask Polytechnic in Singapore.

The equipment used in the training program includes 80386 CPUs, 80387 coprocessor equipped PCs with colour graphic monitors, printers and plotters. Each participant has a complete workstation.

The major CAD software used in the program is CADKEY 3.5, while the major CAM software is MASTERCAM 3.0. Computer Numerical Control (CNC) milling and grinding machines are used for the production of project models.

Engineering experts and trainers in CAD/CAM handle the lecture and demonstration sessions. Acting as faculty, they are also available for consultation with the participants, particularly during the project phase. The machining of the project models is done by the participants themselves under the tutelage of the experts and aided by CNC machine operators.

UNIQUE ELEMENTS AND BENEFITS

• by working on prototype development , the curriculum builds in the participants a sense of teamwork, accomplishment and pride

CPSC, in its efforts to provide maximum benefits to participants from developing countries, offers programming in the locations where the best combination of expertise and facilities is available at the most reasonable costs. Throughout the training program, CPSC focuses on the multiplier effect for institution building in developing countries.

By working on prototype development throughout the course, the curriculum builds in the participants a sense of teamwork, accomplishment and pride. It also helps establish linkages and the networks which form the basis for future cooperation within the region.

DURATION OF TRAINING

The training program is four weeks in length, and sessions are held five days a week (usually Mondays to Fridays) for six hours per day. However, most participants work in the laboratory during the evenings and weekends.

PARTICIPANTS

Participation in each training program is limited to twenty-five trainees. The participants are usually instructors or teacher trainers in TVE institutions. They are holders of diplomas/degrees in mechanical/production engineering and have a good grasp of

the English language. Most have some background in engineering drawing, CNC machine technology, conventional machine operations and PC utilization.

ROLE OF PARTNERS

The Commonwealth Industrial Training and Experience Programme of the Fellowships and Training Programme of the Commonwealth Fund for Technical Cooperation has provided funding support for the participants from Commonwealth countries. The Industrial Centre of the Hong Kong Polytechnic University has provided facilities and experts who act as resource persons for the program. In the future, CPSC expects to develop a close relationship with Temasek Polytechnic.

In Hong Kong, field visits were arranged by an IC-HKPU staff member to the Hong Kong Productivity Council, Chen Hsong Ltd. and Hong Kong CAD/CAM Services Ltd. During these visits, participants were able to see the CAD/CAM process in action in industrial setings.

TESTIMONIALS

During recent CAD/CAM training, Dr. C.K. Basu, CPSC Director, described the value of the program.

> *In 1990, the first Industrial Training Program in CAD/CAM was launched. The practice-oriented course, intended mainly for technical teachers handling courses in CAD/CAM, aims to provide participants with the basic principles and operations of CAD/CAM. The program is viewed as extremely valuable considering the relevance of high technology, including CAD/CAM, to industry, particularly in the regional countries. The potential for a multiplier effect confirms my confidence that CPSC's mission will be actualized, and both CPSC and the Industrial Centre at Hong Kong Polytechnic University, will be recognized as centres of excellence in technician education and training.*

Speaking at the Opening Ceremony of the CAD/CAM training program in 1991, Professor Poon Chung-kwong, Director of Hong Kong Polytechnic University described the importance of this type of training.

> *CAD/CAM and Computer Numerical Control (CNC) are advanced technologies which will increase productivity. There is a range of products which can only be produced with these technologies. It is, therefore, important for developing countries to acquire these technologies to increase their competitive power in international markets.*

Finally, M.P. Michael, Director of Secondary Technical and Vocational Education at the Ministry of Education, Nicosia, Cyprus, thanked the CPSC Director following the first offering of this program.

We take this opportunity to express our sincere appreciation for the good organization and implementation of the training in CAD/CAM ... the opportunity given to two of our technical school teachers to participate in the training program enriched their knowledge in helping us implement the subject in our curriculum.

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Electromechanics Maintenance
Industrial Technician

offered by

Dualtech Training Centre Foundation, Inc.
Mantrade Building
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Metro Manila, Philippines

THE PROGRAM

In late 1981, acting on feedback from Filipino businessmen regarding the growing problem of lack of skilled manpower, and observations on the enormous problems associated with poverty in the Philippines, officials of the Centre for Research and Communication (CRC) and Hanns Seidel Stiftung (HSS) of Germany embarked on what was then called the "CRC Manpower Project". The project was designed to "contribute to poverty alleviation in the country, train workers for local industries, promote the growth of the national economy and adapt the dual system of training from Germany." The Electromechanics Maintenance Program was a major outcome of that initial project activity.

The 28-month program develops the skills of trainees in the electrical, mechanical, and electronics fields. It produces multi-skilled industrial technicians with expertise in the maintenance and repair of all types of electromechanical machinery and equipment.

The program is divided into two parts, Basic Skills Training and Advanced Skills Training, through which the electrical, mechanical and electronics skills are developed.

Dualtech education is industry subsidized. The cooperating company, where a trainee is placed during the in-plant phase of the training, shoulders 70% of the cost of the training. This subsidy makes the program accessible to the poor.

• *the company shoulders 70% of the training cost*

THE DELIVERY

Dualtech is known for its so-called "Dualtech" Training System, which is an adapted version of the German Dual System where there are two venues of learning: the school and the company. Together, these venues collaborate to develop an effective and efficient learning program. The first eight months of basic skills training is conducted entirely in the school. The last twenty months, described as advanced skills training, follows the adapted dual system. In this component, the trainees are in the school two days a week and in the factory four days a week. The content of the training plan is jointly developed by the school and the company.

• *there are two venues of learning: the school and the company*

The second element of the dual system applied in Dualtech is the combination of skills training and work values formation. This creates highly productive skilled

workers who are both quality-trained according to the needs of industries and who have positive work attitudes.

SPECIALIZED RESOURCES

• *Dualtech developed and fabricated its own trainers*

Dualtech uses trainers (simulators) in the school portion of the training program to imitate industrial technology manufacturing operations and processes. To minimize costs and improve the trainee/equipment ratios, Dualtech developed and fabricated its own trainers in the mechanical, electrical, and electronics trade areas, combining reverse-engineering and the utilization of indigenous materials. Dualtech has developed trainers for industrial motor control, motor rewinding, electropneumatics, electronics and computer numerical control.

UNIQUE ELEMENTS AND BENEFITS

This program encompasses a host of unique elements that create valued added benefits for the trainee, industry and Filipino society. These include the following:

- learning is applied immediately, a technique that accelerates the learning process;
- private companies shoulder 70% of the cost of training, making the training more accessible to the poor;
- graduates get the equivalent of a 36-month program in 28 months, ensuring that trainees are job-ready as quickly as possible;
- work values and skills training are combined, creating productive workers who command above-average salaries;
- 60% of trainees are hired before graduation, and 100% are hired within sixty days of graduation;
- the pool of well trained local workers increases, resulting in the need for fewer foreign employees;
- under the "dual system" of school and work placement, six hundred and fifty students are trained with only four hundred training places, thereby multiplying the capacity of the educational system without substantially increasing the infrastructure investment or the direct costs.

DURATION OF TRAINING

The Dualtech Electromechanics Training Program is twenty eight months (approximately 5,000 hours) in duration. Other courses offered by Dualtech vary in length of time for completion.

PARTICIPANTS

Current day time enrolment is approximately five hundred. This is expected to increase to seven hundred by early 1995. Evening enrolment is approximately three hundred and fifty.

Dualtech's success rate and impact have attracted regional interest and four groups of trainees from the Apprenticeship Training Institute in Sri Lanka have been trained.

ROLE OF PARTNERS

Dualtech's industrial partners play a very vital role in the program through a number of initiatives. For example, they assist the school in developing and improving the curriculum, provide the workplace learning environment, assume 70% of the cost of training, and donate training equipment and provide capital investment.

Dualtech has a partnership network with over two hundred companies and training institutions (including those from outside the country), of which fifty to sixty are active at any one time. Examples of industry partners include San Miguel Corporation, CF Corporation, RFM Corporation, TEMIC Telefunken Semiconductors, Phelps Dodge Inc. (Phils), Johnson & Johnson Inc. (Phils), Hoechst (Phils), Union Glass Corporation (Phils), Philips Components (Phils), and Litton Mills Inc.

• *Dualtech has a partnership network with over two hundred companies and training institutions*

TESTIMONIALS

The Dualtech system has been formalized by the government and the Dual Training System Act of 1994 was recently signed into law. This legislation was initiated in 1991 by the government's executive and legislative branches, with strong support from industry. Since 1989, Dualtech has been an active consultant to the Department of Education, Culture and Sports.

Norma Blas, Personnel Manager with TEMIC Telefunken Semiconductors Phils. Inc., has direct experience with Dualtech trainees.

> *TEMIC Telefunken has trained fifty-one Dualtech scholars and 39 of them have been absorbed after graduation as regular employees, with several occupying supervisory positions... the fact that we never let Dualtech scholars go after they complete their apprenticeship speaks for our high regard for their competence, excellent work discipline, profound interest in learning new methods and approaches, inherent love for work and burning ambition to improve their craft. It is not surprising that we have a high regard for Dualtech.*

Mr. Luz Gatchalian, Production Manager with Penn-Goldzack Philippines, has praised the system of training and the quality of the graduates.

> *... [the] Dual Program has been very beneficial to both the trainees and the company. All the Dualtech graduates working with us have refined work*

> *values and have been consistently delivering good performance. They are well motivated and highly productive workers. Their competence is high and they are better paid than other employees.*

Vic B. Santos, Assistant General Manager at Sun Valley Manufacturing and Development Corporation, recently wrote to Dualtech.

> *We have, working with us, three of your alumni. One is now a team leader of the Tool and Fixture Section of the machine shop, another has been assigned to our electro-mechanical maintenance section, and the third works as a technician/operator in our central compression supply system. ... your educational institution ... produces people of rich skills, knowledge and values.*

Dr. H. Neulling of the German Ministry of Economic Cooperation in Bonn, Germany, recently wrote to Dualtech, noting "your facilities and the impact of your training on human capital formation and the socioeconomic development of your country are impressive."

Noel J. Alvarez, graduate of the class of '88 and currently employed as a Supervisor with Siliconix (Phils) Inc., said that one of the most important things he learned as a Dualtech student was ..."the value of hard work and sacrifice which helped me improve my technical skills ...". This is strong praise for the work values element of the program.

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Industrial Technician Program
Electrical, Electronics & Instrumentation

offered by

Meralco Foundation Institute
Ortigas Avenue Ext.
Pasig, Metro Manila 1605
Philippines

THE PROGRAM

Established in 1973, the Meralco Foundation Inc. (MFI) is a science foundation dedicated to the development of the Filipino society, with an emphasis on helping the economically disadvantaged. Its mission focuses on the education and training of Filipinos with a particular interest in promoting the values associated with science and technology. One of the best known and most highly regarded programs of the MFI is the Industrial Technician Program (ITP).

The Industrial Technician Program is a three-year, post-secondary, non-degree course of studies which relies on an integrated system of training that combines theory and practical applications. The program includes classroom presentations, laboratory experiments, workshop activities, and actual in-plant training where the trainees apply their knowledge and skills in three areas: electrical, electronics, and instrumentation. Human formation activities, including courses on human resource development and social sciences, as well as tutorial classes and individual counselling and seminars on human development, complement the technical training and instill in the trainees the attitudes and values necessary for the world of work.

The objectives for this training program are highly developed. They include: providing industry with high quality technical manpower using a holistic training approach that combines skills development and values formation; equipping the trainees with technical skills required by industry; developing the appropriate attitudes and values in the students, which are necessary for effective performance and productivity in the work place; exposing the students to and familiarizing them with the atmosphere of work through on-the-job training; providing prospective employers with the opportunity to assess students' technical capabilities, work attitudes, and adaptability in different working conditions; developing the students' entrepreneurial skills and promoting self-reliance; and fostering parental involvement in the education of children through seminars and continuing dialogue with class advisers.

The three-year curriculum combines classroom and laboratory activities, as well as workshop practice in the areas of electrical, electronics, and instrumentation technologies. There is a total of 1,320 hours of in-plant training where the trainees apply their knowledge and skills in an on-the-job atmosphere.

THE DELIVERY

The first year of studies combines nine months of in-school training with 320 hours of in-plant training. During the second year, there are nine months of in-school training. In the third year, there are four and one half months of in-school training combined with 1,000 hours of in-plant training.

The in-school training consists of classroom instruction, laboratory activities and workshop practice. To facilitate learning, both group and individual activities have been incorporated into the program.

SPECIALIZED RESOURCES

Specialized resources are of three types. First are the laboratory and equipment facilities at the training institute. Despite financial limitations, every effort is made to ensure these are up-to-date and that they reflect the type of equipment the student will experience in the world of work.

• *teaching materials, have been designed and developed by MFI faculty and staff*

The second specialized resource is the teaching materials. These have been designed and developed by MFI faculty and staff, and reflect years of experience in the field of industrial training.

The third specialized resource is the industry partnerships that allow for student placement and learning in the workplace. These have been developed over a long period of time, and are an important resource that is critical in helping MFI realize the program objectives.

Finally, it should be noted that MFI creates saleable educational training equipment. This produces modest revenue that is directed towards a scholarship program for students in financial need.

UNIQUE ELEMENTS AND BENEFITS

The curriculum of the ITP is the result of an extensive study of the needs of industry through surveys, interviews and consultations with industry personnel. The ITP curriculum was developed to ensure its responsiveness to the demands of industry. A feedback system is in place in the form of linkages with those industries that employ students and graduates of the program. Through these activities, the ITP is continuously assessed. Further, there is close and direct monitoring of the curriculum delivery system to ensure that what the instructors are delivering is in fact what is required by the curriculum outlines.

• *technical education cannot be isolated from total human development*

Through the Total Development Program of the Guidance Department, trainees and their parents are encouraged to understand that technical education cannot be isolated from total human development. The ITP incorporates the development of sound values and attitudes that complement the knowledge and skills acquired in technical education. Similarly, the skills and values of the teachers undergo continuous formation through professional development programs in order to help them become better facilitators of total human development. MFI promotes the strong involve-

ment of teachers in the design, development, and production of educational software and hardware.

The integrative approach taken by MFI in the ITP helps the trainees develop not only into good technicians but also good citizens.

DURATION OF TRAINING

The total length of training is three years, incorporating twenty-two and one half months in school and approximately 1,320 hours on the job.

PARTICIPANTS

Participants are sixteen to twenty-two years of age. All are high school graduates. Six hundred and seventy-two trainees are enroled, and the numbers in years one through three of the program are almost equal.

ROLE OF PARTNERS

The nature of the program ensures close cooperation with industry. Partners include Matsushita Electric (Phils) Corp., Hopewell Energy (Phils) Corp., Colgate-Palmolive (Phils) Corp., Amkor Anam (Pilipinas) Corp., and American Microsystems Inc.

The role of the partners includes participating in curriculum development activities, providing the in-plant training component of the curriculum, providing in-service training for instructors, sending employees to participate in upgrading programs/seminars conducted by MFI, providing employment for graduates, and providing feedback on the performance of graduates.

The Department of Education, Culture and Sports provides general guidelines for the implementation of the program and monitors the training, as is the case with all private educational activities in the Philippines.

TESTIMONIALS

Mr. Edzel R. Escala, training Supervisor of Matsushita Electric Philippines Corporation (MEPCO), has expressed full support for MFI's technician program.

> *We shall continue to accommodate trainees from the Institute in the years to come. We express confidence in MFI's worthy undertakings and we hope that MEPCO will continue to be a part of the Institutes's efforts to mould its students and hone their technical skills.*

Wilfredo Cruz, an ITP graduate now employed by MEPCO, has described how his supervisor selected him to be sent to Japan for further training, largely because he is a product of MFI. He credits MFI with the fact that he has a stable job and would like to thank the Foundation for.

> *committing themselves to the noble task of [teaching] poor but capable and talented students, and helping [these students] become some of the best technicians ...*

A third testimonial comes from J. B. Meaney, Station Manager of Hopewell Energy (Phils).

> *We are indeed grateful to Meralco Foundation for providing such a high calibre technician training programme. We find the students to be honest and keen to learn. They also possess a good attitude towards their work and their coworkers. These young scholars will play a vital role in our company's future.*

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Industrial Skills Training Program Development
Electronics, Construction, Mechanical & Trades

offered by

Office of Manpower Skills Development
National Manpower and Youth Council
East Service Road, South Super Highway
Tagig, Metro Manila
Philippines

THE PROGRAM

The Office of Manpower Skills Development (OMSD) was established in 1969 as an Executive Branch of the National Manpower and Youth Council (NMYC). The OMSD Centre develops and packages new and innovative short term industrial technology training programs to be replicated at Regional Manpower Skills Centres located at fourteen sites within the Philippines.

Since the OMSD was first constituted, the manpower and training needs of the industrial technology sector in the Philippines have become more sophisticated and technologically advanced. As a result, OMSD has adjusted its vision, mission and objectives to cater to a very broad scope of clients in order to effectively serve the changing manpower development needs of the country within the field of industrial technology.

To date, OMSD has developed and implemented comprehensive, freestanding course programming in a number of related fields. These include: electronics, telecommunications, construction, metals, and garments. Within these fields, the programs of study have been designed to deliver employable skills within the respective industries.

OMSD continuously develops new courses in order to keep abreast of the fast paced technological changes taking place within the Philippines. This supports the overall commitment of NMYC to provide for the manpower needs of the fastest growing industries in the country as well as supplying manpower for the foreign labour markets served by Filipino Overseas Contract Workers.

There are two types of training centres through which the specialized industrial training programs are delivered. The first is the Advanced Training Centre (ATC). These centres offer courses in the trades areas to industry workers, vocational/technical trainers, engineering graduates, and Filipino overseas contract workers. As well, these centres offer technical assistance directly to industry. The ATC's are fully equipped, led by management teams, staffed with trained instructors, and supported by well qualified technicians. The ATCs focus on advanced training in computer applications, electronics and telecommunications, mechanics, land transport, and construction.

The second type of training centre is The Specialized Training Centre (STC). The STCs provide basic to intermediate level industrial skills training that relies on adjunct or community based instructors as well as OMSD staff. In general, these facilities are fixed, but require less specialized support than the ATCs. The STCs focus on training in metal trades, equipment maintenance and safety, and the garment industry.

• *programming is generally industry led*

Programming in the centres is generally industry led. Companies assist with the provision of equipment and technology, thereby ensuring the training is appropriate and up-to-date. Aside from regular training, customized programs are introduced on a regular basis to meet specific industry training needs.

THE DELIVERY

The training is conducted in settings that double as both laboratory/workshops and lecture rooms. These are equipped with audio visual tools, instructional simulators, machinery, tools, and instruments. The practical exercises consist of sequentially progammed activities that the trainee must perform at a specified level in order to successfully complete the program. The lectures are supported by print materials, while the practical exercises are complemented by job skills worksheets. The trainee to machines/tools ratio is maintained in a range from 1:1 to 1:4.

SPECIALIZED RESOURCES

• *the "hands-on" approach is a critical element in this type of skills development*

The computer applications training is supported by a variety of microcomputer systems, applications software and peripherals, including digitizers, scanners, laser printers, and plotters. The electronic and telecommunications programming is supported by digital trainers and a variety of electronics instruments. The electromechanics training includes programmable logic controllers and sequence control trainers. Land transport training is complemented by multi-valve engine trainers and diesel fuel engine trainers. Trainees in the construction field use TIG/MIG welding machines as well as ultrasonic welding detectors. Metals students work with computerized numerical lathe machines and computerized milling machines. Finally, garment industry training makes use of lockstitch, embroidery, and high speed sewing machines, as well as overedging, button hole and bartack machines.

UNIQUE ELEMENTS AND BENEFITS

• *a Worker Attitude Development Program ensures that the trainees will approach the workplace with a positive and constructive outlook*

The "hands-on" approach to training is a critical element in this type of skills development. At the conclusion of the training program, graduates are work-ready because they have spent many hours using the same equipment that will be part of their work environment. Also, the short term duration of the training, from forty to a maximum of four hundred hours, ensures a very focused program with a very fast entry to the workplace.

Each training program includes a Worker Attitude Development Program (WADP) that guarantees trainees will approach the workplace with a positive and constructive outlook.

The Training for Trainers programming is offered in order to help build the training capacity of other institutions in the country. In this way, OMSD has an ongoing influence on skills training at many institutions throughout the Philippines.

Finally, this programming takes into account the training needs of migrant Filipino workers. In this way, the OMSD program helps support the Filipino economy by ensuring that off-shore workers, most of whom send wages back to the Philippines, continue to be highly competitive in many sub-fields within the broad spectrum of industrial technology.

DURATION OF TRAINING

Programs developed and implemented by OMSD are as short as forty hours in duration up to a maximum of four hundred hours.

PARTICIPANTS

Participants in these training programs come from many different sources, including unemployed youth, displaced workers, workers currently employed but who need upgrading, and migrant workers who are applying to go overseas.

ROLE OF PARTNERS

The OMSD has close ties with many companies and industry groups, non-governmental organizations and vocational technical educational institutions nationwide. These partners assist the ATC's and STC's by means of donating equipment, providing technical assistance, transferring technology through the offering of seminars and the training of instructors on new developments within the specific sub-fields, employing graduates, and establishing trade skills' standards for various occupations.

TESTIMONIALS

OMSD is primarily a developer and facilitator of training activities. Hence, the range and level of organizations willing to work in partnership and support of OMSD is a strong testimonial to their success in the field of industrial technology training. Toyota (Pilipas) Ltd. for example, provided the training facilities and state-of-the-art technology to produce technically trained graduates who now work in urban service centres throughout the Philippines. Tokno Ogawa, General Manager of Overseas Services,Toyoto Motor Corporation, made the following comments at the launch of the Toyota Technical Education Program.

• OMSD is primarily a developer and facilitator of training activities

> *We have the pleasure of appointing the [National Manpower and Youth Council] to provide a learning environment that contributes to automotive professionalism and integrity through Toyota's training system and state-of-the-art technology.*

The Naval Training Command provided training facilities for OMSD programs in training skills methodology. This resulted in increased technical skill capacity

among the Armed Forces of the Philippines (ARP). Also, the Naval Construction Brigade provided services and equipment for the training of heavy equipment operators whose critically important expertise was required following the Mount Pinatubo disaster. Pablo P. Perez, Commander of the Naval Construction Brigade, Armed Forces of the Philippines, had this to say about the program.

> *The training ... had a remarkable impact in developing skills among our trainees. The trainees [were] ready for special assignments at the disaster areas serving the victims of the Mt. Pinatubo Volcano eruption. ... The Armed Forces of the Philippines looks forward to more joint training efforts ...*

Finally, Mr. Leo L. Espino, Chairman of the Executive Committee, Metro Manila Youth Skills Olympics '92, described the quality of the National Manpower and Youth Council services and facilities.

> *The technical services of OMSD technical instructors during the skills competition assured the successful conduct of the event. Noteworthy of praise were the venue and the training facilities which were used for the [Youth Skills Olympics].*

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Technical Training for Engine Production

offered by

BeiNei Group Corporation
18 Med Donghuan Road
Beijing, 100022
P.R.C.

THE PROGRAM

BeiNei Group Corporation – Beijing Engine Works (BEW) – is the largest manufacturer of engines in the People's Republic of China. It is a large scale, state-owned enterprise, which has been operational since 1949. At present it employs a staff of approximately 24,000 workers, including more than 4,300 engineering technicians and administrative personnel. The Corporation possesses fixed assets in excess of 1,250 million yuan.

• *Beijing Engine Works employs approximately 24,000 workers*

In China, BEW's engine output covers one-sixth of total engine output, and its economic and technological quotas, as well as its market share, rank first among its counterparts in the P.R.C. Within BEW's Education Centre, there is a Training Centre, Worker's Engine College and a Technical School. Approximately 150 full-time faculty are employed by the Education Centre, including lecturers, engineers and professors. In addition, a number of other experts and professors from universities and institutions both from within China and abroad participate in the Education Centre's activities as visiting teachers or advisors.

The training program includes three major elements: (1) elementary industrial skills and management training; (2) basic level on-the-job training; (3) advanced on-the-job training.

The elementary industrial skills and management training is carried out by the Engine College and the Technical School. The goal of this training is provide basic skills for shop level workers and managers. Training is full-time. Within this school, there are thirty professional teachers, including engineers, senior engineers, professors, and lecturers. Currently, more than 1,000 graduates of the Engine School work in a variety of technical and management positions at the Corporation.

Basic level on-the-job training includes three components: first is applied vocational training supervised by technicians or engineers; second is theoretical and conceptual training delivered through traditional lectures and independent learning modules; and third is training in occupational habits and practices, presented for the most part through lectures and by example.

Computers and a host of other equipment required in this training initiative are readily available in the lab, school factory and computer centre. Depending on the specific job, the training may take anywhere from 50 to 200 hours. More than 20,000 BeiNei Group workers have received on-the-job training for more than 250 different job categories.

The third element, referred to as the advanced on-the-job training program, has incorporated four separate initiatives. The first of these, operational since 1988, has focused on training workers and technicians to operate and service eight automatic engine production lines provided by General Motors, USA. Eighty students were recruited from the Engine College to complete a three year program of study which trained them in the operation of engine production machines. Graduates from this program currently play important roles in the factory. In addition, approximately one hundred technicians and engineers were sent to the United States in order to obtain specialized technical training related to the engine production lines. This training was provided by U.S.technicians and engineers. Also, engineers and experts from both the U.S. and China have been invited to the Beijing factory in order to assist in on-site training. The results of these training initiatives have been tangible and immediate. Although BeiNei spent $1 million U.S. on training, it saved $6 million U.S. on the cost of technology imports.

The second major component in the advanced on-the-job training program has involved training in production practices. Workers take part in a six-month to one year training program that includes 500 hours of classroom study. Graduates practice their new skills in the workshops, and do special design work and production practice problem solving related to their future work postings. After attending this training program, more than three hundred middle level skilled workers from many different job categories have implemented about 150 technical innovations.

The third initiative involves advanced business training for directors of branch factories and companies as well as heads of departments. The training has been designed to help the Corporation meet the needs of a market economy by changing managers' traditional thinking about business issues as well as increasing their skill levels in the areas of policy development and decision-making. Computer simulations are used to demonstrate the workings of a market economy environment. These same simulations also provide training related to managerial and administrative skills. The teaching materials used in support of these programs have been adapted from universities, both abroad and at home, and experts from research institutes and universities are invited to teach as guest instructors. This training program runs from 15 days up to 3 months, with fifty hours of training being the minimum.

The final training initiative involves a high level auto technology research program designed to keep senior engineers from the Corporation at the forefront of engine technology. This eighteen month program is led by experts from the Qinghua University and Research Institute, which is attached to the Chinese Space Agency. One product of this activity has been the publication of a series of research papers.

• *the focus is on integrating theory and practice, with the emphasis on applications that relate directly to factory production*

THE DELIVERY

In the elementary skills training program and in the basic level on-the-job training, traditional lecture methods are combined with hands-on applications, including computer simulations. The focus is on integrating theory and practice, with the emphasis on applications that relate directly to factory production. In the advanced on-the-job training, workers have been exposed to textbook and lecture methods, factory training overseas, computer simulations, problem solving and research driven learning models.

SPECIALIZED RESOURCES

The Education Centre itself is the largest and most important specialized learning resource, along with the variety of faculty drawn from within the Corporation and those seconded from other institutions. Typical of other learning institutions, the Education Centre is equipped with classrooms as well as computer labs which have been designed specifically for technical training. Prior to being put into production, the automatic engine lines had been used for training.

UNIQUE ELEMENTS AND BENEFITS

The size, variety, complexity and the degree to which the training responds directly to the needs of the corporation reflect the unique elements of the program and speak to the benefits. All training programs at BEW relate directly and immediately to the specific jobs to which trainees are assigned. In addition, the training is dovetailed in such a way that students may move fluidly from one level of education to another as their jobs and responsibilities evolve.

• students move fluidly from one level of education to another as their jobs and responsibilities evolve

Unlike many large organizations, BEW is fully capable of meeting its own training needs, without relying on other organizations to supply entry or mid-level workers.

DURATION OF TRAINING

The duration of training varies considerably, depending on the type of training offered. At the basic level, training at the Engine College may take from two to three years of full time study. The basic level on-the-job training typically lasts from 50 - 200 hours for a specific course or level of training. Senior skilled workers training, which is part of the advanced on-the-job training, usually lasts from six months to a year, though the advanced research program is 18 months in duration. Business training is routinely scheduled for three months.

PARTICIPANTS

The training program is comprehensive in nature, and affects virtually all new and experienced employees at the Corporation. As a result, a training culture is embedded in the institution, as every worker has come to expect the "training experience" as part of the work experience. In fact, most workers welcome and look forward to the opportunity for upgrading and training through the activities of the Education Centre.

ROLE OF PARTNERS

General Motors is a major partner assisting with the import of technology.

The Beijing Association for Adult Education also works in conjunction with BeiNei, providing certification for individuals who successfully complete the basic training program. As well, professors from domestic and international educational institutions, including universities and technical institutes, are key participants in BeiNei training programs.

TESTIMONIALS

Mr. Guo Futian, Deputy General Manager and Head of the Personnel & Education Department at BeiNei Group Company, has said,

> *The Training Centre has made a very great contribution to the development of our company through a wide variety of training activities. Workers have increased and updated their skills, bringing greater efficiency to BeiNei. The participation of General Motors U.S. has been especially effective and beneficial.*

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Skill Training in the Petroleum Industry

offered by

The Chinese National Petroleum Engineering & Administrative Training Centre
North-China Petroleum Workers' College
Guan, Hebei 102700
P.R.C.

THE PROGRAM

The Professional Skill Development and Training Centre of the Chinese National Oil and Gas Corporation was established in 1992 with the mandate to upgrade the professional skills of petroleum workers and support the "Corporation's Ten Year Development Plan" by creating a pool of high quality labour.

After a thorough needs analysis, and in conjunction with the Chinese Psychological Research Institute of the Chinese National Science Academy, this comprehensive, computer-based, petroleum technology and skills training program was developed. It provides basic technical skills and knowledge in specialized job areas in order to meet the ever-changing needs of the petroleum industry both in China and abroad. Training in English language skills has been included in this program in order for Chinese workers to keep abreast of changes in petroleum engineering technology worldwide.

The organization of the training program emphasizes maximizing the training level and content while minimizing the time away from the job. The training program consists of full-time study, followed by on-the-job training supervised by on-site professors.

• *maximizing the training level and content while minimizing the time away from the job*

All trainees who take part in this program have at least two years work experience. The employers pay for the trainees to undertake the training program, which may last from a few weeks to as much as three years. Upon completion of the program, trainees return to their parent company. Trainees must pass an entrance examination before being admitted into the Training Centre.

THE DELIVERY

All of the Training Centre's programs are computer-based. The software was developed by Training Centre staff. It covers the delivery of technical skills and knowledge, and includes evaluation tools that track student progression through the learning packages. All training is modularized; students must successfully complete one module before moving to the next.

• *all of the Training Centre's programs are computer-based*

Students are encouraged to work at their own pace and instructors are available to answer questions and help solve problems as required.

SPECIALIZED RESOURCES

Specialized resources and approaches include:

Multi-Media Computer Classroom: A multi-media computer teaching lab, equipped with audio, video and text, and networked via NOVELL netware. This lab is the primary teaching tool. The Windows based technical software, developed by Chinese experts, covers a wide range of topics and problems in oil drilling, oil machines, electric power, and petroleum engineering administration, typically involving computer simulations of realistic problems encountered in the petroleum engineering industry.

Audio and Video Teaching Classroom: A classroom consisting of audio and video recording and copying equipment. It is used for developing and delivering audio and video based instructional programs, educational film development and the creation of computer software programs.

Simulation Training Device System: A system consisting of computer controlled equipment and computer simulations. This makes it possible for trainees to practice and develop skills without using the actual field equipment. This system is primarily used to carry out technological skill standardization training and develop skills in problem identification, analysis, assessment, and resolution. It is also used for training students in petroleum related emergency response.

Expert Experience Inquiry System: A database which has been created to store highly technical information provided by experts in a number of petroleum based technical fields. This database is the main clearinghouse for information that students draw upon when solving complex technical problems.

Language Laboratory: A 48-seat language laboratory. Students learn oral and written English through computer-based lessons, and are evaluated through computer-based tests.

On-the-Job Training: Once students have completed their training at the Centre, they are monitored on-the-job. Their supervisors act as on-site professors, coaching and monitoring trainees as they put their new skills into practice.

UNIQUE ELEMENTS AND BENEFITS

This program is unique in several ways. First, the degree to which the program relies on computer-based training means that students can be trained in the most up-to-date equipment and methods and are able to progress at their own pace through the learning modules. Second, given the simulation programs and the expert inquiry system, the training is directly related to the jobs which the trainees will be required to perform. Third, the training incorporates teamwork and cooperation skills. In this

way, students develop effective interpersonal and group work competencies, which are critical attributes in the petroleum industry.

DURATION OF TRAINING

The training program is divided into three categories: short-term accelerated training, medium-term comprehensive training and long-term professional training. All training programs are full-time. Short-term training may last from one to six weeks, and generally focuses on the development of basic skills in topics such as oil well control and directional well training. Medium-term training lasts from three to eight months, and focuses on building multiple technical skills. The long-term training program may last up to three years, and is the most intensive program offered at the Centre. This training provides students with comprehensive skills and knowledge in a number of high level petroleum engineering and administrative fields.

Many students return to the Training Centre to improve their skills as they move through their organizations and are required to perform more complex, higher level tasks. These training sessions are arranged as required, at the request of the employers.

• *students return to improve their skills as they move through their organizations and are required to perform more complex, higher level tasks*

PARTICIPANTS

The Training Centre caters to the needs of the petroleum industry throughout the country. It can seat 200 participants at one time. As of August 1994, 120 students were enroled full-time at the Centre. All students at the Centre have completed junior middle school prior to entering the Training Centre. In the higher level programs, many of the students are college graduates.

ROLE OF PARTNERS

The Professional Skill Development and Training Centre was established by the Chinese National Oil and Gas Corporation. Its mandate is to provide relevant technical training that is responsive to the needs of the oil industry; consequently, it regularly consults with and seeks advice from the industry. The program is under the administration of, and financed by, the Hebei Petroleum Administrative Bureau. It has established a long-term relationship with the Chinese Psychology Research Institute of the Chinese National Science Academy. The Research Institute provides input and direction regarding effective learning theories and practices for professional training.

TESTIMONIALS

Wang Bao-ji, Director of the North-China Petroleum Workers' College, had this to say about the program,

> *This program is unique in China. Many other industries and professional training centres would like to emulate the activities and standards of our*

college. The college is well known by individuals and industries throughout China. Students who have completed their training at the Centre have gone on to work in Canada, India, Lebanon, and a variety of other countries.

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General Management Program in China (GMC)

Management Development for Managers of Industrial Enterprises

offered by **Beijing Institute of Economic Management**
Wang Jing Zhong Huan Nan Lu No. 5
Chao Yang District
Beijing, P.R.C.

THE PROGRAM

The General Management Program in China (GMC), jointly sponsored by the Beijing Institute of Economic Management (BIEM) and the Swedish Institute of Management, is a management development training initiative for senior managers of large and medium-sized, state owned, industrial enterprises. The program was proposed in 1982 and launched in 1984 by the Swedish Institute and the Chinese government as a pilot project. The focus of the program is corporate strategy and international business. The overwhelming success of this effort led to the creation of the Institute.

Each course is four to six weeks in length. Training sessions have been held in Beijing and in Tianjin, one of the most industrialized cities in China. Four hundred and fifty Chinese managers have been trained through the program, mostly directors of factories, top managers of companies, and senior officials.

The aim of the program is to introduce the participants to management theory and industrial practices common in the industrialized world. This will assist Chinese industry to meet the high demands of industrial enterprise management in concert with the current economic reform taking place in the P.R.C. The program content focuses on strategic production practices and international business, crucial issues facing most industrial managers in the P.R.C.

THE DELIVERY

The program is delivered in English by Chinese and Swedish faculty. Lectures, group work, classroom presentations, games, case analysis, computer simulations, and field work are the principal methods of course delivery.

The field work elements of the program provide participants with an opportunity to apply what they have learned to actual business settings. For the last week and a half of the program, participants are split into groups and sent to various companies to identify issues and problems, gather information, and propose solutions. Upon return to the classroom, they present their findings to their colleagues and receive practical comments and constructive criticism.

A new dimension to the program has been implemented as of 1994 in order to respond to the sweeping changes taking place as part of the fast paced, economic development in the P.R.C. This change formalizes two week industrial placements in Sweden as a standard element in the training program.

SPECIALIZED RESOURCES

Overhead projectors, audio-video resources and computers are frequently used in the program. Also, it is common for representatives from Swedish industrial companies as well as Swedish financial institutions to take part in the program as resource people.They describe their experiences, offer insights into some of the case studies and develop links with the participants. Wherever possible, actual Sino-foreign joint industrial ventures are used as cases.

Senior Chinese government officials are a valuable resource for the program and provide the faculty with up-to-date information on economic reform. This adds an air of currency to the program which would otherwise not be available.

UNIQUE ELEMENTS AND BENEFITS

This program is a strong example of excellent international co-operation in industrial management training. It enjoys solid support from the governments and industrial circles of China and Sweden. Curriculum design is a dynamic process, geared to the changing economic conditions in China. Modifications to the curriculum are made in concert by the Chinese and Swedish professors.

Lectures, combined with on-site exercises and practical applications, are well received by the participants, and industrial experts from China and Sweden are deeply involved in program activities. Recently, case studies based on Chinese enterprises have been developed by the faculty. Another outcome of this program has been the translation of teaching materials into Chinese.

• *many of the participants have been promoted after taking part in this program*

By implementing the concepts and strategies learned through this training program, a number of enterprises have made demonstrated improvements in their overall management and hence their productivity. Further, many of the participants have been promoted after taking part in this program.

Contacts made during the program among faculty and students have provided an excellent opportunity to promote better understanding and ongoing linkages between Chinese industrial managers and visiting faculty.

DURATION OF TRAINING

This program is generally run once a year, with each course being four to six weeks in length.

PARTICIPANTS

Four hundred and fifty participants have been trained in this program. Approximately 80% have been directors or deputy directors of large or medium-sized industrial enterprises, 15% were high ranking officials of the government administration in charge of economic development and policy making, and 5% were management teachers or instructors from BIEM and other institutes.

The program is delivered on a full time basis, six working days per week. For the participants and the faculty, the program workload is very heavy.

• the program is delivered on a full time basis, six working days per week

All participants have university degrees or the equivalent and the majority have strong engineering backgrounds.

ROLE OF PARTNERS

Swedish faculty assume the major teaching role in this program; BIEM assists by adapting curriculum to fit the Chinese environment. It is BIEM's intention to offer portions of the program without direct assistance in the near future.

Swedish industries play an important role in the program by providing industrial managers as resource personnel and by documenting specific business problems and experiences. This has been and continues to be an important supplement to the main program. Chinese factories play a key role by providing the field work settings.

Both the Chinese and the Swedish governments have provided strong support to the program insofar as financing and facilitating the necessary formalities associated with organizing the program.

TESTIMONIALS

The program is strongly supported by the president of BIEM and, wherever possible, experience gained from the program has been disseminated through nation-wide conferences. Given the level of support that has been provided, it is apparent that the program is highly valued by both the Chinese and Swedish governments.

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Telecommunications & Computer Engineering Training

offered by

Shanghai Post
& Telecommunications Training Base
276 North Suzhou Road
Shanghai 200085
P.R.C.

THE PROGRAM

The Shanghai Post and Telecommunications Training Base is a large communications training enterprise operated under the Ministry of Posts and Telecommunications. It consists of various training units, and is responsible for updating and retraining on technical subjects related to the telecommunications industry. Examples of training courses include switching technology, fibre optic transmission, mobile communications, digital microwave technology, computer engineering and English language training.

The Base has a staff of 200, including associate professors, lecturers, instructors, senior engineers, junior engineers and administrative personnel. Most of the instructors at the Base have both theoretical training and practical experience in their field.

• *the Shanghai Base trains telecommunications personnel from the Asia-Pacific region*

As one of four Post and Telecommunications Training Bases in China, the Shanghai Base trains telecommunications personnel from the Asia-Pacific region and is also involved in regional cooperation projects organized by UNDP. In recent years, visitors from Belgium, the U.S., England, Germany, Japan, Spain and Malaysia have visited the Base, some as guest lecturers and others as trainees.

THE DELIVERY

Classroom training is augmented by simulation exercises using equipment available at the Base. Trainees are also taught on-site at local communications companies, where the instructors from the base are assisted by on-site engineers who work for these companies. This element of the program ensures that the training experience mimics real life applications in the telecommunications field.

SPECIALIZED RESOURCES

At the Base, all the classrooms are equipped with standard equipment including projection systems. In addition, the seminar hall utilizes an on-line computer projection system.

The base is also outfitted with switching equipment, a microcomputer lab and an English language lab that is equipped with audio-visual resources and recorders.

UNIQUE ELEMENTS AND BENEFITS

The combination of classroom training and on-the-job training experiences and simulations means that trainees can combine the theoretical with the practical and immediately apply their new or updated skills when they return to their places of employment. The technologies and techniques are regularly updated, but are not so new as to be out of synchronization with the equipment the trainees experience and must work with in the field.

• trainees can combine the theoretical with the practical and immediately apply their new or updated skills when they return to their places of employment

The size of the training program is quite large, with two hundred professional staff. In addition, the mix of Chinese and foreign trainees in the classroom means that students can share problems and experiences and thus broaden their learning experience.

DURATION OF TRAINING

Training courses vary from two weeks to three months in length depending on the technology involved and the level at which the workers are expected to perform.

PARTICIPANTS

The Shanghai Training Base has trained almost 2,000 individuals in telecommunications technologies. All trainees are full-time students who have been granted leave by their respective companies in the telecommunications industry. At the conclusion of their training, all trainees return to their companies. Most trainees have graduated from a technical college.

ROLE OF PARTNERS

The Base has signed a long-term co-operation agreement with Beijing University of Posts and Telecommunications, Nanjing University of Posts and Telecommunications, Shanghai Fudan University and Shanghai Jiaotong University. Through these partnerships, students from the Base attend selected lectures at the universities, professors from the universities visit the Base as guest lecturers, and students enroled at the universities visit the Base for selected lectures and exercises.

TESTIMONIALS

The Shanghai Post & Telecommunications Education Centre has been named an "All-China Advanced Training Institute" by the following organizations: the Labour Department; the Production Committee of the State Council; the State Education Committee; the State Personnel Department; the All-China Federation of Trade Unions; All-China Worker's Education; the China Skilled Training Association; and the China Adult Education Association. This is high praise, and reflects the currency of the training, the dedication of the staff and the efficiency of the programming.

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Diploma in Manufacturing Engineering

offered by

Nanyang Polytechnic
German-Singapore Institute (GSI)
Jurong Campus
10 Science Centre Road
Singapore 2260

THE PROGRAM

Established in 1982 under the Economic Development Board as a cooperation project between Singapore and the Federal Republic of Germany, the GSI has been working closely with institutions and industry leaders to introduce new technology, technology applications, and training systems into Singapore. The GSI was transferred to Nanyang Polytechnic effective February 1, 1993. Under the School of Engineering of the Polytechnic, the GSI plays an instrumental role in developing technologists with specialized knowledge in manufacturing and in introducing the latest manufacturing know-how to Singapore.

At the school, pains are taken to create a "Teaching Factory" environment to provide effective and realistic learning experiences. Within this environment, students are given hands-on training on advanced high tech equipment and systems, and real life experiences on industrial projects that meet competitive specifications, quality and delivery standards. The program philosophy states that the best teaching aid is the machine which the students will use in industry. After two years of broad-based, hands-on training, students specialize in high value-added areas of development and manufacturing activities such as Industrial Automation and Robotics, Advanced Manufacturing Technology, Plastics Manufacturing Technology, and Manufacturing Software. All students must complete a full-time 18-week project phase, either in-house or with industry.

• *the best teaching aid is the machine which the students will use in industry*

THE DELIVERY

The Institute's organizational structure is geared to industrial standards. For example, students and teachers are required to be present for 44 hours per week. There are only two weeks leave between semesters. When students enter or leave the Institute, they must clock in and out. In fact, the entire equipment set-up of the GSI is more akin to that of a modern industrial enterprise than to a school.

• *students and teachers are required to be present for 44 hours per week*

In addition to supervised work during the semester, there is a major examination at the end of each semester which determines whether the student will be promoted. After the formal training is concluded, the project phase begins. Students form teams, and each team works on a complex technical project for industry or the Institute, according to stringent specifications and deadlines. In this phase, companies such as Hewlett-Packard often bring equipment to the Institute and supervise the project.

SPECIALIZED RESOURCES

Similar to a modern manufacturing company, the Institute has areas for manufacturing and technical laboratories. These include the Department for Product Development and Design; various production workshops for metal machining, CNC Technology, Laser Cutting, and Plastic Technology; workshops for Tool & Die Manufacturing and Heat Treatment; and laboratories for Materials Management, Materials Handling, Automated Assembly, and Robotics.

However, the most interesting element in the system is the model Computer Integrated Manufacturing Centre (CIM Centre), established to enable staff and students to develop their robotics technology skills in an environment that has integrated the various technologies relating to business, engineering, and production. The physical layout consists of two cells: the Flexible Machining Cell (FMC) and the Flexible Assembly Cell (FAC); and a Flexible Material Handling and Storage System (FMHSS). The FMC incorporates two CNC machining centres, a CNC turn-mill and a coordinate measuring machine (CMM). Assembly and disassembly activities are carried out by the BOSCH and SKILAM robots in the FAC. The FMHSS consists of one automated storage/retrieval system (AS/RS) and two bi-directional automated guided vehicles (AGV). Both AGVs have different configurations in handling material transfer due to the requirements of the two cells. Thus, each AGV is dedicated to one cell in order to transport materials between the components of the cell and the AS/RS. Other features of this Centre include MAHO 5-axis machining centres and the Carl Zeiss Coordinate Measuring Machine.

UNIQUE ELEMENTS AND BENEFITS

The full-time 18 week project phase involves teams of four to six students assisted by a coordinator. The students work on projects such as the independent design, construction and manufacturing of a complex technical system for the field of applied automation. One example would be the development of a unit for the automatic assembly of a packaging machine. Additional work to be performed by the teams includes scheduling and organization of production, purchasing of supplies, as well as cost calculation. The results of the project are documented in a comprehensive project report and form part of the final examination. At the end of the semester, the project is presented to an examination board which evaluates and marks the performance according to fixed criteria. The students' performance, the results, and their work attitude and social behaviour in the team is evidence that this project-oriented phase of learning is an excellent training technique.

With its strong multi-disciplinary approach, the CIM Centre serves a unique purpose within GSI. CIM covers all activities related to the manufacturing business including evaluating and developing different product strategies, analyzing markets and generating forecasts, designing components for manufacturing, and evaluating and/or determining batch sizes, manufacturing capacity, scheduling and control strategies related to design and fabrication processes.

DURATION OF TRAINING

The program includes two and three year courses leading to the award of the Diploma in Manufacturing Engineering. The semester is broken into two terms of practical and theoretical work. The first term consists of eight weeks of instruction with a one week break followed by seven weeks of instruction and three weeks of study and examinations. In the final year, students must complete the eighteen week project phase.

PARTICIPANTS

Currently, the enrolment figure for the full-time diploma program in Manufacturing Engineering is 964. GCE 'A' Level holders with at least two Advanced Level passes, including a Mathematics subject, plus a pass in a General Paper (English) or a good pass in English Language at GCE 'O' Level, may apply for the two year program. GCE 'O' Level holders may apply for the three year program provided they possess a minimum of three passes in required subjects.

ROLE OF PARTNERS

GSI at Nanyang regards its active and close collaboration with its transnational cooperation partners - governments, organizations, institutions, and industry leaders both local and international - as strategic and central to its mission to provide "Education for The Next Lap" (the Singapore Government's vision for the next stage in its industrial and business development).

The importance attached to links with industry is not just a theoretical concept, but a concrete day-to-day reality in Manufacturing Engineering at GSI. For example, the Industrial Project Group (IPG), structured like a business, oversees projects developed by a team of full-time engineers and designers, and supported by final year students. In 1992, the IPG successfully completed 54 projects with clients such as Hewlett-Packard, Philips, Apple Computer, and Maxtor Singapore. In addition, the advisory board consists of distinguished representatives from Material Handling Engineering, Pepperl + Fuchs Mfg., Festo Private Limited, and SFK Manufacturing. GSI also actively collaborates with technology partners such as Autodesk Inc., Carl Zeiss Pte. Ltd., Mitsubishi Heavy Industries Ltd., Seiko Instruments Singapore Pte. Ltd., Siemens Nixdorf Information Systems, and Traub AG.

• *the Industrial Project Group (IPG) completed 54 projects with clients such as Hewlett-Packard, Philips, Apple Computer, and Maxtor Singapore*

To enhance the training further, staff are sent on attachments to organizations and companies locally and overseas to gain first-hand experience. Some of the overseas partners include China, Vietnam, France, Australia, the U.K., and Germany. There is a program that brings directors, managers, engineers, and teachers from China to participate in GSI training. Some of the institutions involved are the Chinese-German Vocational Centre of Tianjin, the Precision Machining Centre of Beijing, and the Chinese-German Training Centre of Beijing.

TESTIMONIALS

The German-Singapore Institute of Nanyang Polytechnic's School of Engineering achieved distinction in October 1991 when it became the first institution outside Germany to win the prestigious German Mechanical Engineering Award conferred by the German Machinery and Plant Manufacturers' Association (VDMA). The citation states:

> *Its didactic concept, its project-oriented approach to training within a comprehensive and practice-oriented environment....its future-oriented curriculum have made GSI an internationally exemplary institution,...the concept of a "teaching factory" enables students to study, construct and work like a modern production facility under realistic conditions.*

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Diploma in Computer Studies

offered by

Ngee Ann Polytechnic
Centre for Computer Studies (CCS)
535 Clementi Road
Singapore 2159

THE PROGRAM

The Diploma in Computer Studies Program conducted in Ngee Ann Polytechnic's Centre for Computer Studies (CCS) provides an education that meets the needs of students who aspire to become Information Systems professionals. At the conclusion of the program, the students not only understand the principles and concepts underlying computer studies, but also have practical experience in all phases of computing. This element is developed through an intensive project component in the program. Integrated into the technical aspects of the program, moreover, are the development of communication skills, interpersonal skills, and problem solving skills.

The Diploma in Computer Studies in CCS is comparable to the best in the U.K. and elsewhere. The British Computer Society, in fact, has recognized the exceptional nature of the program by giving it exemption accreditation for Part 1 of its professional examinations. In the first year of the program, students are provided with a solid foundation consisting of concepts and hands-on skills upon which the more demanding components of the program build. This approach provides GCE 'A' Level students sufficient assimilation time to master the fundamentals which are necessary for the highly specialized second year. In this year, five intensive assessment blocks, namely Systems Analysis and Design, Software Systems Development, Computer Systems and Networking, Database Management Systems, and Systems Development Management, precede the unique Project component which brings together all the students' skills in a single ten-week block.

• *the British Computer Society has recognized the exceptional nature of this program*

Students with GCE 'O' Level qualifications also have the opportunity to enrol in the advanced courses by participating in a one year preparatory studies program.

THE DELIVERY

Teaching is delivered mainly through lectures, tutorials and practicals. Substantive teaching is done using a team approach in which five to seven staff members collaborate on a single assessment block. The students, therefore, see a problem from many different points of view and learn rapidly to integrate their knowledge rather than merely compartmentalize disparate elements. The staff team must prepare thoroughly for this delivery method, requiring ongoing operational meetings.

The students are organized into groups of twenty for tutorial and practical sessions. These are supervised by a tutor from the teaching team. Here the students focus on making the connections between theory and practice. To reinforce the concepts that

the students have learned, external speakers are invited to address real-life problems and situations. These speakers come from such well-known companies as Yamaha Music (Asia) Pte. Ltd., Port of Singapore Authority, Metamedia Systems Pte. Ltd., and the Development Bank of Singapore.

Students are given many opportunities to learn and discover on their own, and to take advantage of the extensive library collection. Also, CCS has its own Resource Centre. Set up near the labs, this Centre provides the students with ready access to computer manuals and a wide variety of software.

SPECIALIZED RESOURCES

To meet the practical aspects of the program, CCS has extensive, state-of-the-art computing resources that include UNIX servers, network servers, advanced workstations, and microcomputer systems which are supported by extensive local area networks in an open systems environment.

To create a more effective learning environment, CCS also provides remote computing facilities services to the Advanced Diploma students and electronic mail facilities to all CCS students.

For student use, the microcomputer resources include 486SX, 486DX and Pentium processors. These are ALR DART/POWER FLEX PLUS, ICL DRS40, ICL DRSM75, OMNI TECH DX2, DIGITEK 486 DX2 and DIGITEK Pentium systems. Advanced workstation resources include more than ten SUN SPARC stations connected by a SUN network. These microcomputers and workstations support the teaching of systems analysis and design, systems architecture and systems programming, and software development. In addition, a range of microcomputers are available for staff use. These are linked on a separate Microsoft NT Advanced Server Network. To support the large number of microcomputers and advanced workstations, totalling more than 600 units, there are twenty-nine UNIX stations and file servers installed in CCS.

With the introduction of the Advanced Diploma course in Data Communications and Networking, a wide range of data communication equipment has been installed. This includes a PABX, six WAN protocol analyzers, one LAN protocol analyzer, eight ISDN PCs with eight ISDN lines, and others. The networking laboratory consists of several LAN topologies (BUS, STAR, and RING), interconnected by bridges or gateways.

To support the academic activities, office automation and CCS management information systems, a LAN consisting of MS LAN Manager 2.2, an MS NT Advanced Server, SUN UNIX servers, ICL UNIX servers, and a PC clients network have been installed. An FDDI backbone has also been installed at CCS. This 100 Mbits/sec fibre optic cable backbone links the networks, servers and computers on the various floors in the CCS building and provides a comprehensive and flexible mode of operation to meet the needs of students and staff.

UNIQUE ELEMENTS AND BENEFITS

The CCS Diploma in Computer Studies has produced more than 2,000 graduates in its eleven year history. This is approximately 15% of the national Information Technology professional workforce in Singapore. The program has enjoyed wide acceptance by the industry, as well as by local and overseas tertiary institutions. Staff attachments involve Hewlett-Packard, Mitsubishi, University of Leeds, National University of Singapore, Microsoft Institute of Advanced Technology (Australia), and others.

• CCS has produced approximately 15% of the national Information Technology professional workforce in Singapore

Graduates from this program enjoy employment as analysts/programmers, and many have gone on to assume senior roles in the information technology field. Employers of the graduates include G.M. Singapore, Bank of China, Ministry of Finance, Singapore Broadcasting Corporation, Singapore Airlines, National Computer Board, Smith Corona, Sony Systems Design International, Singapore Computer Systems, and Great Eastern Life Insurance.

DURATION OF TRAINING

The Diploma in Computer Studies is a two-year program. Candidates with GCE 'A' Level qualifications or equivalent are admitted into the first year of the program. Candidates with GCE 'O' Level qualifications or equivalent may also be admitted into the program but must first successfully complete a one year preparatory course of study in the Centre. The preparatory year is 32 weeks at 30 hours per week, the first year is 32 weeks at 28.5 hours per week, and the second year is 22 weeks at 30 hours per week. The final project period is ten weeks, full-time.

PARTICIPANTS

The students tend to range from seventeen to nineteen years of age, with the majority entering directly into the program with 'A' level qualifications and C grades or better. Most have obtained three 'A' level passes. The student enrolment in CCS as of December 1994 consisted of 120 'O' level students and 120 'A' level students in the first year, and 60 'O' level students and 220 'A' level students in the second year.

ROLE OF PARTNERS

At a broad level, the CCS Advisory Board oversees the formulation of policies and strategies at the Centre. The members of the Advisory Board include a wide cross-section from the industry. Presently, the Advisory Board is chaired by Mr. Yeo Khee Leng, the Assistant Chief Executive of Corporate Services, National Computer Board, which has the statutory responsibility to co-ordinate computer education at a national level. The Advisory Board members also represent various professional bodies in Singapore such as Singapore Network Services, Overseas Union Bank, Singapore Telecommunications, and POSB Computer Services. The Advisory Board provides a vital link for CCS with the industry, as well as the national policy makers.

The Centre constantly seeks partners from industry. Through these partnerships, the Centre is able to keep abreast of the changes in computer hardware and software used for teaching. These partners also help facilitate attachments and training for the Centre's teaching staff.

Many organizations are heavily involved in ensuring the students receive quality hands-on instruction by participating in the final year Project. These organizations include Citicorp Investment Bank, Exxon Chemical Singapore, Mass Rapid Transport Corporation, Photographic Society of Singapore, Shell Petroleum, and the Celini Design Centre.

TESTIMONIALS

Mrs. Pearleen Chan, the Managing Director of Singapore Network Services Pte. Ltd. and President of the Singapore Computer Society, was the Guest of Honour at the 1993 graduation. She noted,

> *Graduates of the Centre for Computer Studies have been fortunate to have received an excellent education in computing....You have very qualified and experienced staff to teach you the use of the most up-to-date equipment. The standards of the courses are very high and all have been accredited by reputable professional societies and organizations. The qualifications you have obtained are recognized not only in Singapore but also internationally.*

Chairman & Managing Director of ICL, Mr. Peter Bonfield, said in his 1992 CCS 10th Anniversary Lecture that,

• *CCS has developed into a Centre of Excellence*

> *I can see that not only has CCS achieved its original goals, but it has gone far beyond and developed into a Centre of Excellence in I.T. Education & Training. I welcome this opportunity to publicly congratulate Dr. Tay Eng Soon, Senior Minister of State for Education, Mr. Tan Chin Nam, of the National Computer Board, and all of you who have played a part in making CCS the success it is today.*

In his speech at the Signing Ceremony of the Memorandum of Understanding between CCS & Microsoft Singapore Pte. Ltd. in 1992, Guest of Honour, Mr. Lew Syn Pau, Member of Parliament for Tanglin, concluded,

> *Today marks another milestone in the development of CCS which is already recognized by many as a centre of excellence in I.T. education.*

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Diploma in Mechanical Engineering

offered by

Ngee Ann Polytechnic
Department of Mechanical Engineering
535 Clementi Road
Singapore 2159

THE PROGRAM

The Mechanical Engineering Department at Ngee Ann Polytechnic offers courses that enable students to build a sound foundation in the principles of engineering and, following graduation, gain technologist and often middle management employment in the general engineering, manufacturing, construction and building services industries. Most of the modules in the common first and second years require both theoretical and hands-on training, with particular emphasis on laboratory experiments and workshop practice.Within these modules, students are encouraged by highly qualified teachers to express their creativity through open-ended mini-projects. In the final year, students apply their knowledge and creative flexibility to a small group project that requires planing, coordination, and team work. These projects are especially important in that they are sponsored by industry.

• *students are encouraged to express their creativity through open-ended mini-projects*

Ngee Ann addresses the technical needs of industry, while also endeavouring to produce well-rounded students with strong leadership qualities. Under staff direction, students participate in creativity workshops, peer tutoring, engineering displays and contests, and activities supported by the Mechanical Engineering Society.

THE DELIVERY

In general, the Department stresses the workshop method of training and allots approximately 50% of the curriculum to hands-on instruction. Out of necessity, formal lectures are given to large groups, but all students are able to take advantage of small tutorial classes, laboratory sessions, and independent reinforcement through the staff designed multi-media component.

In the second level modules, namely, engineering design, creative design and productivity, and quality studies, students work in small groups and must devise creative solutions to problems set by staff. Although each group receives the same specifications, each must determine its own unique approach and solution.

In the final year, students work on a "design and build" project. Eighty percent of the students work on polytechnic based group projects while 20% work on industrial group projects. The purpose of the project is to have the students solve industrial problems and satisfy needs related to small and medium size enterprises. This program helps the students to appreciate the nature of industrial problems and the constraints they have to face on the job.

SPECIALIZED RESOURCES

About 50% of the program is delivered in the classroom environment using standard teaching aids in a lecture format; however, the balance is delivered by well trained academic and technical staff in tutorial sessions, specialized laboratories, and workshops where the students have the opportunity to handle industrial type equipment and machines. CAD/CAM facilities at Ngee Ann are of a very high standard and among the best in the region. Also, students have access to the latest in Computer Numerical Control Technology (CNC), robotics, computer aided production planning and the Flexible Manufacturing System in the manufacturing enterprise.

As an alternative to the standard lecture format, lectures are sometimes conducted by teams of teachers. This approach emphasizes the integration of knowledge from various areas, and helps students appreciate the interrelationships found in different industrial processes.

• *the Department has developed some of its own software for interactive learning and assessment*

Multimedia presentations are also being used in the classrooms as well as in the laboratories. In addition, the Department has developed some of its own software for interactive learning and assessment. Students use this software to reinforce their skills in engineering subjects, and it also has the capability of generating adaptive questions for testing purposes. This unique package can actually show machine parts in movement and in relation to each other; guides and clues are built into the program to lead students through the intricate steps involved in machine theory and operation.

UNIQUE ELEMENTS AND BENEFITS

The emphasis on hands-on practice to complement theoretical teaching is not only evident in the curriculum itself, but also in the wider context of the school and the community. Many of the compulsory student projects are sponsored by companies and medical institutions. These "real problems" test the students' design abilities and innovative thinking. Some of these sponsors include Setsco Services Pte. Ltd., Epan Cable & Wire Pte. Ltd., Jurong Bird Park, Compact Metal Industries, Proflex Industries Pte. Lt., and General Hospital (Singapore).

• *The Department organizes industrial visits during the vacation period*

The Department organizes industrial visits during the vacation period to provide opportunities for the staff to see the rapid developments taking place in the workplace, as well as to interact with counterparts in industry. As a result, 35% of the academic staff are involved in consultancy work. In 1992 the department set up nine Interest Groups to organize visits and technical talks to enhance the intellectual development of the staff. The Design Interest Group has promoted a "Design Awareness Week" which includes a design seminar, exhibition, and competition. Secondary school students are encouraged to participate in this event. The seminar and exhibition provide opportunities for students to share their design experience and enhance their understanding of various design concepts. Students also participate in the Inter-School Robot Competition which tests their ingenuity and practical mechanical abilities while working within very precise rules and requirements.

The program teaches students to be conscious of the quality and productivity aspects of mechanical engineering while displaying leadership, inventiveness, and group co-operation.

DURATION OF TRAINING

The program length is three years full-time (six semesters of eighteen weeks each), with approximately twenty-six hours per week of classroom instruction and hands-on work.

PARTICIPANTS

The Mechanical Engineering Diploma program has approximately 2,000 full-time students with an annual intake of 750 - 800. All students enter the program with passes in at least five GCE 'O' Level subjects, including English language, mathematics, and science.

ROLE OF PARTNERS

Ngee Ann Polytechnic has strong industrial and institutional links, both locally and overseas. The Advisory Committee consists of many distinguished members from companies such as Material Handling Engineering Ltd., GE Motors Pte. Ltd., Texas Instruments Singapore Pte. Ltd., and GM Singapore Pte. Ltd. Also represented are the Materials Engineering Division and GINTIC Institute of CIM from Nanyang Technological University. These links provide visiting lecturers, industrial attachments for staff, industrial projects for students, consultancy projects for staff, and opportunities for joint projects.

Close links with industry have helped the Department to shape courses, develop staff, and provide students with opportunities to visit, interact with, and develop a realistic appreciation for the industrial environment. Other partners provide links with Germany, Switzerland, England, Australia, and the United States. The Princeton in Asia Program offers yearly visits, and the International Fellows Program links staff with counterparts from England and Germany.

TESTIMONIALS

Mr. Peter Boo, Managing Director of Materials Handling Engineering Limited, has described the importance of a strong manufacturing industry and the role played by the Mechanical Engineering Department of Ngee Ann Polytechnic.

> *Singapore achieved rapid economic growth over the last two decades. Manufacturing and related service industries contributed significantly to this growth. The well educated and disciplined work force is the key to such rapid progress and development. By providing the necessary middle managers to industry, the Mechanical Engineering Department has played its role well. As an employer of these graduates, I have been very pleased with their performance.*

Mr. Choo Siew Chuan, Plant Manager at REDA Pump Company (Singapore), echoes these thoughts.

> *The Mechanical Engineering Diploma course offered by your institution is a well structured engineering education program that supplies a valuable technical workforce to Singapore industries. Its modern teaching facilities and established course curriculum allow students not only to acquire the*

fundamental engineering knowledge, but also provides them with opportunities to interact with industries during the course of their studies. The graduates adaptability and innovative approach to problem solving has earned the Polytechnic a good reputation as being the "Polytechnic of Industry" ...

Mr. Loke Yoon Cheong, Chief Engineer/Manager at Philips (Singapore) Ltd., and external examiner for Ngee Ann, has evaluated and described the diploma program.

Students have hands-on experience with up-to-date equipment as well as industry machinery. This enables students not only to have the practical experience so vital and necessary in an engineering course, but also to assume the responsibilities at the workplace without much hesitation. In addition, the compulsory 8-week vacation training programme enables students to appreciate the industrial environment that they will face after graduation ...

• *the compulsory 8-week vacation training programme enables students to appreciate the industrial environment*

A graduate of the department, Miss Khong Lai Meng, speaks very positively about her experience at the Polytechnic.

Since leaving Ngee Ann Polytechnic, I joined URACO AUTOMATION (S) Pte. Ltd. as an Assistant Engineer. Initially, the work involved turnkey automation projects, but for the last fifteen months I have been working on a project using an Automated Guided Vehicle (AGV). I do systems installation, programming and maintenance. The knowledge that I gained during the diploma course in the Mechanical Engineering Department is very useful and appropriate. The machines and equipment we used in laboratories are actually industrial type and hence no mental adjustment was required.

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Precision Tooling/Machining

offered by **Precision Engineering Institute (PEI)**
15 Kallang Junction
Singapore 1233

THE PROGRAM

The Precision Engineering Institute (PEI) specializes in the training and development of skilled manpower for the precision engineering industry, training which is critical for the manufacturing and supporting industries in Singapore. PEI uses the "teaching factory" concept in its approach to training. Under the supervision of experienced staff, the training is conducted in a simulated modern shop environment within the institute. PEI incorporates actual manufacturing processes into the practical projects.

Industrial partners, through various cooperative projects with PEI, support the training program by providing machinery that features the latest in technological developments. PEI staff maintain close rapport with companies to keep pace with the changes in economic direction and development and, as the needs of industry change, PEI adapts.

• *industrial partners support the training program by providing machinery*

At PEI, the training year is comprised of two, twenty-five week terms in order to reflect industry practices.

THE DELIVERY

Basic theory is delivered in a traditional classroom setting; however, the majority of the training is completed using practical exercises on the shop floor. Job-related discussions of theoretical concepts take place right at the machine work-stations.

A student may be located at a single machine for up to one week before moving to the next in the sequence. Staff supervise the shop as they would supervise on the job. A unit manager handles the logistics of the floor and the progression of the students. Students of varying levels interact with each other, as they would in a factory. Adaptability is a primary concern in PEI's program.

SPECIALIZED RESOURCES

Within the "factory," there are standard, up-to-date basic turning, milling, grinding, and drilling machines. PEI also has some of the most powerful and modern equipment found in any institution, through various agreements. For example, Bridgeport Machines Limited (UK) provided for the installation of the latest Bridgeport CNC Machining Centre model VMC 560 with two units of 2-station training consoles, Heidenhain 2500 & 407 Controls, E-Z Cam software and a Renishaw Digitizing package. Autodesk Incorporated (US) equipped PEI with seventy-five sets of

AutoCAD kelease 12 (version C2) and twenty-five sets of Manufacturing Expert J2 software at a substantial discount.

Saeilo Japan Incorporated has recently equipped PEI with two software packages of CIMATRON 90. This superior and powerful software is an integrated 3D CAD/CAM System for mould & model making, which allows users to do Surface Modelling, NC programming and solid modelling. With the software, users can eliminate "prove out cuts" and modify tool paths when their design model changes. Immediate graphic verification allows the user to see the cutter section, on-screen, before the first cut is made.

UNIQUE ELEMENTS AND BENEFITS

• leading-edge machine tools are used in the training program

One particularly outstanding feature in the PEI training environment is the use of leading-edge machine tools in the training program.

Also, transnational partnerships in the form of cooperation projects with specialized manufacturers and multinational companies, such as those mentioned in the specialized equipment section, keep PEI at the forefront of the industry. Further, these projects enable full-time students at the institute and industry personnel, who come for short, specialized courses, to be exposed to the latest application technologies.

PEI's goal is to develop practical specialists in Precision Engineering thereby meeting the labour requirements of local industry. This is accomplished by developing real-life industrial project exercises with actual cost, quality, and delivery schedule constraints. Although mass production is not done at PEI, students do progress from drawing to prototype and production on industrial machines used in industry.

DURATION OF TRAINING

The length of training for the National Technical Certificate Grade 1 is one year of full time study. For Grade 2, it is two years of full time study. Each year, students train 44 hours per week for 50 weeks.

PARTICIPANTS

Students must have completed secondary education at GCE 'O' or GCE 'N' Level. For NTC-1, students must have completed NTC-2 in Precision Engineering courses with three years of relevant experience.

ROLE OF PARTNERS

PEI is proud of its skill oriented factory concept and works in close collaboration with industry in many ways. Staff attachments range from Germany and the U.K. to the U.S. and Japan. These attachments expose PEI staff to the latest methods used in different engineering environments. Staff then transfer this knowledge to the students.

PEI also hosts seminars involving organizations such as the Singapore Institute of Standards and Industrial Research, Singapore Precision Engineering and Tooling Association, Traub-Heckert-Klink, INMAC Singapore Pte. Ltd., and Erowa Inter AG. PEI's partners are leading specialized manufacturers and multinational companies located in Singapore. These include Siemans Nixdorf, Mitutoyo, Bridgeport, Sodick, AutoDESK, Nissei, and Charmilles.

Many of PEI's industry partners provide production jobs for application training, and many sponsor students who, after completing the training, return to these companies as full-time employees. Companies that hire PEI students include Microfits & Methods Pte. Ltd., Matsushita Technical Centre Pte. Ltd., and LeBlond Makino Asia Pte. Ltd. These partners ensure that PEI staff and students are at the cutting edge of modern technology.

• *partners ensure that PEI staff and students are at the cutting edge of modern technology*

TESTIMONIALS

Manfred Schuetz, Managing Director of Wild (S) Pte. Ltd., describes the value of PEI.

> *The high standard of training in PEI is one of the major factors which made the production of our precision instruments in Singapore possible and successful. PEI upgrades its training consistently and thus we have no difficulty implementing and utilising the latest production technologies.*

Lim Cho Koen, Managing Director of LeBlond Makino Asia Pte. Ltd. comments on the training program.

> *The well structured and intensive training programs in PEI make their trainees very versatile in meeting the varied operational needs of our work stations. The trainees' versatility has also facilitated our implementation of technology-transfer programs speedily.*

Jimmy Chew, Managing Director of Microfits & Methods Pte. Ltd., describes how he relies on PEI.

> *Microfits has grown 5-fold over the past six years. We specialise in designing and fabricating high quality IC moulds, supplying to the world market. Today, 95% of Microfits' skilled manpower are graduates from PEI. These hardworking, smart and well-trained people are able to handle modern machine tools such as CNC, EDM and CNC Mill with minimum in-plant training efforts. This facilitates the introduction of new technology that is imperative for productivity improvements.*

• *95% of Microfits' skilled manpower are graduates from PEI*

And finally, K Kondo, Managing Director of the Matsushita Technical Centre (S) Pte. Ltd., says,

Since the start-up of Mastec's operation in Singapore eight years ago, the core of our skilled workforce has been mainly recruited from PEI. We find that these trainees are able to adapt and perform their jobs effectively and in a short period of time within the company.

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Diploma in Mechatronics

offered by **Temasek Polytechnic**
School of Engineering
51 Grange Road
Singapore 1024

THE PROGRAM

The Mechatronics program at Temasek Polytechnic was designed with the primary objective of creating "thinker-doer" technologists. The program equips students with the theory and practice to meet the changing needs of the manufacturing and processing industries. It leads to the Diploma in Mechatronics. To achieve this objective, only staff who have at least five years of hands-on engineering experience are selected to teach in this program. Further, the program has been tailored to emphasize industrial practices.

The first year subjects provide students with a basic foundation in Engineering. In both semesters, the students are trained in Programming/Problem Solving Techniques using C Language and Technical Communication Skills. In the second year, the courses reinforce and expand upon the students' understanding of their first year subjects. In addition, second year courses are more design and process oriented, and the students are required to complete a 12 week Industrial Attachment Program during which they contribute to in-house engineering projects, trouble-shooting production lines, and maintenance activities on the shop floor. At the end of the Attachment Program, the students are evaluated on their engineering knowledge and their work attitude. In the third year, the subjects focus on industrial applications. The final year project requires students to conceptualize a product, conduct a feasibility study, design and procure the components, and fabricate the product which is then exhibited to prospective employers. This project takes six months to complete. In addition, third year students must choose four electives from among such subjects as Robotics, Factory Automation, Manufacturing Logistics Simulation, Software Engineering, and Rapid Prototyping Technologies.

• *students complete a 12 week Industrial Attachment Program during which they contribute to in-house engineering projects*

Examples of final year projects include: IC Design, Design of cable tester for Datafield (Singapore), Design of an Epoxy Dispenser, Design of a PC picture phone, Design of a wall-climbing robot, computer aided learning for C programming, and a Tampines Campus Bicycle project. Students are encouraged to be creative, environmentally concerned, and cost conscious in their designs. Designs must incorporate plans for the manufacture and assembly of the product.

Temasek participates in the annual National Entrepreneurship Competition sponsored by the Economic Development Board. The goal of this program is to develop and market a product with industrial partners. Current students have designed and fabricated an SOS System, an emergency paging system for the elderly, and a

Styrofoam Cutting Machine for the signage industry. Two teams of third year students are currently participating in the 3M Competition to encourage innovation.

THE DELIVERY

Approximately 40% of the seventy-five instructional hours per subject in this three year program are devoted to lectures, 20% to tutorials, and 40% to laboratory work/projects, with the high point of the students' activities being the final year project.

SPECIALIZED RESOURCES

After identifying the needs of industry in Singapore, namely product and process design, factory automation, database technology, machine vision and manufacturing logistics, the staff at Temasek developed dedicated laboratories to enhance the practical aspect of the subjects.

The Mechatronics Design Centre houses CAD/CAM application tools, including I-DEAS, Master Series software from SDRC and ANSYS finite element software operating on HP 710 and 715 UNIX workstations. The objective of the third year Computer Aided Design and Manufacturing for Mechatronics course is to provide an overview of CAD/CAM/CAE applications, the related hardware and peripherals, the system capabilities, and the operating environments. It covers the Electronic and Mechanical design cycles, design methodologies, design aids and tools, design verification techniques, and analysis tools.

The Factory Automation Laboratory is equiped with the following machines: a CNC Lathe complete with 32-bit processor, colour monitor, and 3-axis machining capabilities; and a CNC Vertical Machining Centre with a 32-bit processor, colour monitor and four-axix machining with a rotary table. Incorporated into the controller functions are complete and up-to-date special features like graphics simulation and tool length calibration. In this lab students are trained to use Computer Numerical Control (CNC) machines, Robots, and Automated Storage and Retrieval Systems (AS/RS) in a Computer Integrated Manufacturing (CIM) environment. Applications include production of parts with highly complex geometrical shapes, as well as components for tools and moulding.

The Automated Assembly Line for PCB assembly and testing is in the APATL Project Laboratory. The line consists of a PCB loader, robot assembly, wave soldering, buffer conveyor, testing, sorting, and a PCB unloader. This lab integrates the various projects of a mini-automated production line with systems designed and built by the staff.

The Machine Vision Laboratory consists of three different vision systems: Omron (a binary system), Matsushita (a grey level system), and Rahmonic (an RGB colour level system). The objective of setting up this lab was to provide the students with hands-on experience in the exciting field of machine vision. A good example of this application is the vision technology in automated guided vehicles (AGV) in a factory material delivery system and in directing a welding process.

The Robotics Laboratory is equipped with three robotic cells to provide students with hands-on experience: Amatrol-Jupiter (SCARA Type), Amatrol-Apollo (Gantry/Cartesian Type), and Amatrol-Pegasus (Vertical Articulated Type).

Finally, the Integrated Rapid Prototyping System Laboratory is equipped with one Digibotics 4-axis 3D laser scanner, one Laminated Object Manufacturing machine from Helisys, and one Fused Deposition Modelling machine from Stratasys. This environment addresses manufacturers' needs for reducing time-to-market and product development costs. It also provides a platform for manufacturers to understand and apply the current state-of-the-art rapid prototyping technologies, and for the students to understand the concept of time-to-market through practical experience.

UNIQUE ELEMENTS AND BENEFITS

The curriculum provides the students with a strong foundation in electronic and mechanical systems, including product and process design, factory automation, database technology, machine vision and manufacturing logistics.

Products now are becoming more mechatronic in nature. This requires "a union of mechanical, computer and electronic engineering in the design, manufacture, and function of a product" (ASME CIE newsletter, Summer 1989). It is obviously timely for the students to appreciate the intricacies of the union of design and manufacture.

• it is timely for the students to appreciate the intricacies of the union of design and manufacture

With an increasing number of production lines currently using this technology, Temasek Polytechnic mechatronics graduates are in high demand.

DURATION OF TRAINING

The Mechatronics program is three years with a 12 week Industrial Attachment Program, and a major project to be completed in six months. Each first semester is 16 weeks; the second is 15 weeks.

PARTICIPANTS

The program is for full-time participants who have completed a minimum of 10 years education. Applicants must meet the Cambridge Ordinary Level requirement, or hold the Institute of Technical Education Certificate. The 1993/94 intake was 160 students.

ROLE OF PARTNERS

A Mechatronics Centre of Excellence was established with industry support to help achieve the goals of the program. SDRC and Hewlett-Packard gave substantial discounts for their IDEAS software and workstations respectively, and ANSYS contributed CAE software at minimal cost. Also, Digibotic, Helysis, and Stratasys contributed the equipment for 3D laser digitizer, Laminated Object Manufacturing, and Fused Deposition Modelling rapid prototyping machines at a discounted rate.

With the extensive range of product design tools and rapid prototyping machines, the Centre of Excellence has attracted many enquiries and collaborations from companies such as Motorola Electronics Pte. Ltd., Philips Singapore Pte. Ltd., Thomson Consumer Electronics Asia, Siemens Medical Instruments Pte. Ltd., and local, small and medium size enterprises in product design and development activities.

Temasek staff are now able to educate industry in state-of-the-art technology. Many companies shied away from this area because of the high costs, until they were made aware of the tremendous returns. As a result, the staff have been able to broaden their understanding of "actual" design and manufacturing processes. This has enabled them to teach with the knowledge of cutting edge applications and greater confidence. Input from industry through collaboration has also helped to fine-tune the program and methods of teaching.

TESTIMONIALS

When reflecting on Temasek graduates, Bala Murali, Senior Training Officer at Motorola Electronics Pte. Ltd., had this to say.

> *We hired Miss Chua Pai Ling as a Technical Trainer in the Training and Development Department of Motorola. Her area of work covers the development of Technical Training Manuals for the manufacturing operations, and she is also required to train and certify manufacturing operatives from the line on various operations (eg. SMT machines, Robotic machine vision systems, test stations). ...she has shown a good attitude toward work and technical competence for the job ... I would suggest that a large part of her ability to perform can be attributed to the course she had at the Polytechnic - Diploma in Mechatronics. We are proud of her performance at Motorola and believe that the strong foundation that the Polytechnic provided made it possible for us to have such a competent employee.*

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Manufacturing Technology

Graduate Level Training and Short Courses in CNC Programming with CAD/CAM Systems

offered by

Asian Institute of Technology (AIT)
Computer Integrated Manufacturing Lab
P.O. Box 2754
Bangkok 10501, Thailand

THE PROGRAM

The Asian Institute of Technology (AIT), a graduate level research and training institution, provides basic and advanced training in manufacturing systems with equipment ranging from stand-alone computer controlled machinery through to computer integrated systems including FMS (Flexible Manufacturing Systems) and MRP (Manufacturing Resources Planning) systems. The training programs include basic CNC machine operation and programming through to the operation and control of complex CIM (Computer Integrated Manufacturing) systems.

The CIM lab at AIT supports Master and Doctoral level degree training in Manufacturing Systems Engineering, short term training courses for industry throughout the southeast Asia region, as well as consulting and applied research. Short courses include basic CNC programming, operation of CNC lathes and milling machines, operation of 5-axis CNC machines, 3D contouring, 5D contouring, and geometric modelling with CAD/CAM. Consulting programs include selecting and managing complex production environments. AIT staff, with their broad range of expertise, are able to tailor the consulting to fit a wide variety of industry contexts.

THE DELIVERY

AIT has an international staff drawn from 50 different countries, including England, France, Germany, Belgium, Sweden, Finland, U.S.A, Canada, India, Pakistan, Bangladesh, Myanmar, Vietnam, P.R.C., Japan, and Australia. English is the language of instruction in all AIT programming.

• *an international staff drawn from 50 different countries*

Training programs at AIT can be delivered from a top down perspective (management) or from a bottom up perspective (operations and shop floor). The approach can be modified quite easily in order to meet the needs of the particular client group. Faculty and staff are recruited directly by AIT or seconded by sponsors.

SPECIALIZED RESOURCES

Equipment in the Manufacturing Technology Program includes 2D, 3D, and 5-axis CNC milling machines, CNC lathes, a DNC system, CNC training systems (PCs with CNC control interfaces and milling and turning simulations - EMCO systems), Unigraphic II workstations, and 486 computers.

Software includes MRP II systems (including Micro Max and Fourth Shift), Unigraphics, AutoCAD for PCs and HP, Master CAM, Simple ++ (plant simulation), and PLC program systems (Siemens).

Computing platforms include HP, SUN, VAX and PC-Lan. The lab is currently planning to install a Zeiss coordinate measuring machine, a CNC water jet cutter, and a flexible automation system (Festo/Bossh).

UNIQUE ELEMENTS AND BENEFITS

• the student population is regional, and AIT is known equally for high academic quality and cultural acceptance

The international faculty represents a cross section of some of the finest educators to be found worldwide. Their expertise is combined with the international flavour and cross-cultural understanding. The student population is regional, and the AIT experience is known equally for high academic quality and cultural acceptance.

Computer-aided learning packages are available for self study, and an excellent library with a substantial journal collection is only steps away from the laboratory. All students have access to Internet.

• all students have access to Internet

Accommodation and food services are available on campus for students and short-term visiting faculty. The campus itself is located just outside Bangkok, and only a short drive from Don Muang International Airport. As a result, AIT is able to take advantage of bringing international lecturers to the campus for a day or two to meet faculty and address students.

DURATION OF TRAINING

Short courses run from one day to three months. The Masters Degree in Manufacturing Systems Engineering is 20 months in duration, while the Doctoral program requires three years for completion.

PARTICIPANTS

Approximately fifty participants have enroled in short courses during the past three years. For the short courses, participants come from Vietnam, Malaysia, India, Singapore, Taiwan, Indonesia and Thailand. Twenty-five students enrol in the Master's Program each year, and four doctoral students are currently on campus, completing their coursework and theses.

ROLE OF PARTNERS

Financial, human resource and equipment support has been received from the Governments of Japan, Germany, India, Belgium, Austria and Thailand. Particularly helpful are the scholarship that many countries and companies have provided.

In addition, industry has sponsored a number of direct initiatives. Examples include an equipment grant from Zeiss for a coordinate measuring machine and a $1M (U.S.) CIM lab building from the Siam Steel Pipe Company. Joint ventures have

been undertaken with EDS (Electronic Data Systems), IBM, Maho, Zoller and Siemens.

TESTIMONIALS

Dr. Kasem Narongdej, C.E.O. of the KPN-Group of Companies, is an industry representative who is familiar with and strongly impressed by AIT.

> *The short courses offered by the CIM lab at AIT are very well designed to fulfill the urgent need for continuing education [to meet the needs of] the expanding industrial sector in Southeast Asia. The international high-tech environment at AIT, combined with the excellent faculty and staff, makes the CIM lab a unique resource for training in CNC, CAD/CAM and manufacturing resources planning.*

Saquib Bhatti, studying Manufacturing Technology in the joint M.B.A. program offered by AIT and the Punjab College of Business Adminstration in Lahore, has described some of the benefits of studying at AIT.

• *AIT provides students with a unique opportunity to meet many different people*

> *AIT provides students with a unique opportunity to meet so many different people ... the diversity of cultures, knowledge and experiences at AIT [is] really quite remarkable.*

Manandhar Uttam Krishna, a Nepalese doctoral candidate in Environmental Engineering, came to AIT after graduating from the Indian Institute of Technology in Madras. He feels that what he is learning at AIT will help him to help his country.

• *Manandhar Uttam Krishna feels that what he is learning at AIT will help him to help his country*

> *I plan to teach when I return to Nepal. I would really like to do something for my country, and I hope to be able to apply the knowledge and expertise I am gaining at AIT. For me, working in developing countries offers great challenges, both professional and personal.*

Manandhar's dissertation topic, Sewage System as a Circulating Reactor, investigates the potential use of wastewater conveyance systems as treatment reactors. The topic was developed in conjunction with his studies at AIT, and has great potential for application in developing countries. This type of research is indicative of the contribution AIT is making to the region through its graduate program offerings. Manandhar notes that,

> *[My thesis topic] is a very promising project. So far, my experiments have yielded encouraging results. Such a system could be used to provide multipurpose service, including transport and treatment. Definitely, the system can be used in small-scale operations and is an economical alternative to constructing a new treatment plant.*

Chien-min Wu, a civil engineering graduate of Chung-Yuan University in Chinese Taipei, worked for five years as a consulting engineer before coming to AIT.

What attracted me most to AIT is the acknowledged reputation of its geotechnical engineering program. I had to study a lot of technical papers in [Chinese Taipei], and many of these were published by Professor Balasubramaniam ... a respected geotechnical engineering expert at AIT.

• *AIT alumni are making significant contributions to the development of Asia*

In government service, working for international corporations, and as self-employed entrepreneurs, AIT alumni are making significant contributions to the development of Asia. Mr. Laxman Prasad Ghimire (CRD '72), for example, is the State Minister for Water Resources in Nepal. A successful, self-employed entrepreneur before entering politics, Mr. Ghimire was a co-founder of East Consult (P) Ltd., one of Nepal's largest consulting firms. Another AIT alumnus, Professor Pham Phu (WRE '82), has been elected Member of Parliament representing Ho Chi Minh City. Mr. Phu is also Chairman of the Division of Industrial Management at Ho Chi Minh Polytechnic University.

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Bachelor of Industrial Technology (BIT)

offered by

Faculty of Engineering
King Mongkut's Institute
of Technology North Bangkok
1518 Pibulsongkram Road
Bangsue, Bangkok 10800
Thailand

THE PROGRAM

King Mongkut's Institute of Technology North Bangkok (KMITNB) was established in 1959 as a tertiary institution charged with educating and training within the fields of science, technology and engineering. With fifty-six programs, KMITNB has very strong horizontal and vertical linkages in science and technology. KMITNB has thirty-three buildings occupied by 10,000 students and more than 400 teaching staff.

The BIT program was created by KMITNB and the Federation of Thai Industry (FTI) in order to upgrade practising technologists and provide them with the latest expertise in modern industrial technologies. This part-time (evenings) three year program enrols technicians who are working for companies that are members of FTI. The students may be admitted to study in several fields, including Production Technology, Materials Handling Technology, and Industrial Electrical Technology.

The majority of students receive financial support from their employees. The employers are required to pay a special tuition fee of Baht 20,000 per student per semester, in addition to the Baht 3,000 normal course fee. The FTI also charges a Baht 5,000 administration fee for each student enroled in the program. Private (not FTI) students are accepted, but they are also required to pay the special tuition fee. These additional fees ensure that KMITNB is able to provide a BIT program that is at the cutting edge of technological development.

• *additional fees ensure that KMITNB is able to provide a program that is at the cutting edge of technological development*

The curriculum in this program focuses on the application of theoretical knowledge to industrial problems. Students are expected to apply what they learn in this part-time program, immediately and directly to their work environments.

THE DELIVERY

The theoretical elements of the program are delivered through traditional classroom work and lectures. Practical instruction takes place in the faculty workshops and laboratories.

An important and innovative feature of the final year is the major project. For this element of the program, students undertake a supervised project designed to improve a specific aspect of their company's activities. This provides direct benefit

to the company and it also involves the company in the student evaluation process, thereby helping KMITNB strengthen its relationship with the companies.

Examples of student projects include the development of a GPIB interface card for PC-ATs, an AutoCad application for electrical and electronics engineering drawings, the development of a plastic cut and wrap machine, the development of a copper soldering machine, and efficiency improvements for napkin processing machines. In all cases projects are designed to solve or enhance specific applications problems.

SPECIALIZED RESOURCES

Production technology equipment includes a foundry lab equipped with cupola, crucible, and induction furnaces, and a metallurgy lab equipped for micro structure studies, including non-destructive testing (ultrasonic, magnetic particle, eddy current) and hardness testing. Machine tools include CNC drilling, machining, EDM, and metrology facilities.

Industrial electrical technology equipment includes a microprocessor lab, complete with microcomputers, data communications, and networking hardware and software. The automation lab includes process control trainers, various sensors and their circuits, and PLC training facilities. The signal processing lab houses digital/analogue oscilloscopes, logic analyzers, signal generators, and spectrum analyzers. The power electronics training facilities are serviced by the Electrical Engineering Department with equipment acquired through German government support.

UNIQUE ELEMENTS AND BENEFITS

The unique elements of this program include the overall focus, which involves taking experienced and employed technicians who are working in the field and upgrading them to the technologist level. They complete the program with the capability to work as practice-oriented engineers, and have provided innovative value-added to their companies through the final year project while attending school.

• *the technicians continue to work while their technical skills are being upgraded*

The benefits to industry include the fact that the technicians continue to work while their technical skills are being upgraded, students acquire management skills which increase their potential to provide leadership and direction to the company at the management level, and applied industrial related problems are solved through final year projects often providing immediate financial benefits to the company.

The BIT program also provides benefits to KMITNB. These include the fact that academic staff enhance their industrial experience in the applied engineering field, multi-disciplinary interaction is strengthened, close cooperation with industry ensures that course curricula is updated and therefore responsive to industry needs, and the university earns extra income.

Students benefit through upgraded theoretical and practical skills which lead to increased value in the job market and expanded opportunities for promotion.

DURATION OF TRAINING

This special, part-time program is five evenings (21 hours) a week with some weekends for project work. It takes three years to complete, compared to the normal full-time program which lasts two years.

PARTICIPANTS

The program was launched in 1992 and enrols an average of forty-five students each year. Thailand has a two stage vocational/technical education system. After three years of secondary school a student may opt for taking a three year course for a vocational Certificate (Por Wor Chor), and may continue for a further two years to obtain a Diploma (Por Wor Sor). To enter the BIT program a student must have a Technician Diploma and at least two years industrial experience. Students in this program are typically 22 - 23 years of age, and the vast majority are male.

ROLE OF PARTNERS

The lead partner in this program is the Federation of Thai Industries. The Manpower Development Committee of FTI was concerned that the supply of skilled manpower was falling short of requirements due to the rapid industrial expansion of Thailand. Although the vocational colleges were producing technicians both at Certificate and Diploma levels, this did not meet the demand for personnel with applied engineering skills who could specify, install and maintain modern factory equipment that combines elements of mechanical, electrical, electronic and computer engineering. As a result, KMITNB was approached by FTI for assistance.

FTI recruits the students for the program and acts as a general interface between the industry and the university. It channels information on industry training needs directly to KMITNB, a task which would be very expensive and time consuming if the university were required to do this with its own resources.

The companies from which the students come play a critical role in the training relationship. First, they have provided the students with practical experience and a strong knowledge of company working practices. KMITNB builds on that during the three years of study. Also, the companies provide an opportunity for KMITNB lecturers to enhance their industrial experience, and they also call upon the faculty to provide consultancy services. Participating companies include Johnson & Johnson (Thailand), Seagate Technology, Isuzu Motors (Thailand), the Electricity Generating Authority of Thailand, Boonrawd Brewery, Thainam Plastic, Sino-Thai Engineering, Hana Microelectronics, Bangkok Foam, and GSS/ARRAY Technology.

In addition to its BIT program partners, KMITNB maintains institutional linkages with universities and colleges in Australia, Canada, France, Germany, Russia, the United Kingdom, and Vietnam.

TESTIMONIALS

Mr. Khemadhat Sukondhasingha, Chairman of the Federation of Thai Industries, has described the value of this program.

> *We are very happy with the BIT program that KMITNB opened for us. It greatly assists industry to meet the challenge of modern technology. In particular, the evening classes are very useful.*

Dr. Chana Kasipar, President of KMITNB, believes this program exemplifies KMITNB's support of industry in Thailand.

• *this program highlights KMITNB's responsiveness to the needs of industry*

> *This twilight Bachelor of Industrial Technology program highlights KMITNB's responsiveness to the needs of industry. This is the main reason the Institute was founded, 36 years ago.*

Finally, Dr. Bundit Fungtammasan, Dean of Engineering at KMITNB argues that the program "enriches the industrial experience of our teaching staff and helps upgrade the capabilities of technicians in terms of their ability to solve engineering problems."

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PRINTING TECHNOLOGY
Pre-Press Technical Training

offered by **Department of Photography & Printing Technology**
RIT (Rajamangala Institute of Technology)
Thanyaburi
Patumthani 12110, Thailand

THE PROGRAM

The Pre-Press Technology program at RIT incorporates the latest computer technology and computer-linked peripherals. Program elements include typography, illustration, image scanning, retouching, artwork preparation, layout, image setting and plate making.

As the printing industry continues to evolve, there is a growing demand for people well-trained in the new technologies. The Department of Photography and Information Technology at RIT was a natural place for the Thai printing industry to look for leadership in this area. RIT has offered certificate and diploma training in Printing since 1952, and revamped the program when the bachelor's degree was added in 1991. RIT decided to develop this program for several reasons. First, it is a natural extension and growth of the existing Pre-press program; second, the recent acquisition of the necessary computers and peripherals gives RIT the capability; and third, it is a direct response to requests from the business community.

In addition to drawing from the existing Pre-Press program, students are referred directly from printing and advertising agencies. As well, students in related programs, such as Art and Design, are eligible to take the program. The Pre-Press Technical Training program is offered in three formats.

The Basic Program has been designed for the novice in computerized Pre-press technology (primarily students in possession of a three-year certificate, but this may also include printing professionals who feel the need to review and upgrade their training).

The Intensive Program has been designed for the student who needs to learn to integrate the whole range of computerized technology and software programs. Students in this stream will come primarily from business and industry. Screening for appropriate qualifications is required.

Finally, RIT also offers Specialized Programs designed exclusively for printing professionals. This stream is filled with direct referrals from companies looking to upgrade their personnel in specific software and/or technologies. Local industry can custom-design a program by selecting the appropriate training modules.

In all three streams, the program includes an integrated course that consists of typography, illustration, image scanning, retouching, artwork preparation, layout, image setting and plate making.

• *goals include increasing the efficiency of the printing industry*

The goals of the program include developing the skill level of print technology specialists within the region, improving the quality of printed materials, and increasing the efficiency of the printing industry. These needs were identified jointly by RIT and the print industry.

THE DELIVERY

In all three streams students are exposed to a combination of lecture, directed lab, tutorials, and independent project work in the lab. The classroom lecture component comprises nearly 50% of the Basic Program, focusing on an introduction to the components of Pre-Press, as well as the appropriate theory. The remainder of the time is evenly split between guided lab work introducing software packages and independent projects with tutorial guidance.

In the Intensive Program all course work is done in the lab. Through a combination of short lectures and guided tutorials, students master software commonly used in computer printing operations (Pagemaker, PhotoShop, Illustrator, Freehand, etc.). There is of course, a significant component of project work, both guided practice and independent.

In the Special Program the specific needs of the government agency, print business, or public relations firm determine both the content and the delivery. In practice, this program is delivered in small groups within the lab. Tutorials, such as for retouching or package design, are done in the lab, as well. As the groups are small, the majority of the program is self-paced with the teachers working one-on-one with the students.

SPECIALIZED RESOURCES

All of the traditional printing equipment currently utilized in the regular Pre-Press Printing program is used in the Technical Training option. In addition, more specialized equipment is available. Classrooms include slide, 16mm, 35mm and overhead projectors as well as a computer projection unit. The lab itself includes MacIntosh computers with installed software, BGB and CMYK scanners, B & W and colour laser printers, an image setter with computer ad software RIP, film processors, plate makers, plate processors, offset proof press, silicon graphic workstation, DEC workstation, Barco file server and an RGB film recorder.

UNIQUE ELEMENTS AND BENEFITS

Drawing from over 40 years in printing press training, and an affiliation with the Printing House, the new program offers discipline integration at a number of levels. There is integration at the teaching level; not only will regular faculty be drawn from the Printing, Photo and Art areas, but specialized part-time instructors from

industry will also be utilized. There is integration at the curriculum level by drawing from the relevant parts of existing programs in order to precisely address industry needs. Most importantly, there is full integration between RIT and the printing industry as regards the content, placement of students and referrals for training. This is a truly co-operative program.

Another unique feature is the flexibility built into the three streams. There is more in-class theory for the Basic Program, short lectures and hands-on work for the Intensive Program, and guided tutorials and project-work for the Special Program. Naturally, the exit goals of the three programs vary. The Basic Program will give students the broad background in Pre-Press computer systems to immediately start work in the industry. Graduates of the Intensive programs, primarily professionals sent to upgrade their skills, will take their new computer application knowledge back to their workplace and share these skills with their fellow-workers. Trainees in the Special Program will acquire the specific skills sought by their business or company in as short a time as possible.

DURATION OF TRAINING

The Basic Program is a full-time course. It runs for three months, thirty hours per week. The Intensive Program is a part-time course. It includes ten hours of group lecture and thirty hours of guided tutorials and individual work in the lab (under instructor supervision). The Special Program is also a part-time course. Typically, it includes three hours of group lecture and demonstration and an additional fifteen hours of individual practice and project work under the supervision of the instructors.

PARTICIPANTS

The participants in the program vary from stream to stream. The Basic students (approximately 20 students per section) are primarily, but not exclusively, drawn from the existing body of students who have already completed the three year Pre-Press certificate. Their goal is to secure employment in the printing field where they can capitalize on their knowledge of the latest technology. Students in the Intensive stream (approximately 10 trainees per section) are primarily referrals from the printing industry (both government and private), advertising agencies, and public relations firms. Drawing on professional knowledge already acquired, their goal is to integrate the latest computer technology into their current skill set in as short a time as possible. Trainees in the Special Program (five per section) have already acquired graphic design skills and are familiar with Mac hardware and software. They are industry referrals and their goal is the acquisition of specific software application.

ROLE OF PARTNERS

• printing organizations provide resource personnel and part-time instructors with specialized skills,

The partners of the Pre-Press Technical Training Program fall into three categories. Various printing organizations collaborated in designing the program. They also provide resource personnel and part-time instructors with specialized skills, and support participants either by selecting them and paying their tuition, if they are employees, or by hiring graduates of the program. Suppliers offer their support

either through the provision of up-to-date software or through free training in the latest software for instructional personnel. Printers, advertising agencies and large companies support the program through the provision of trainees, aiding in their selection, and paying tuition. They also are the primary employers of the graduates of the Basic Program.

TESTIMONIALS

There is wide-spread support for the RIT Pre-Press Certificate Program, and opinion is very positive about the new Technical Training option.

Mr. Vichai Payakaso, President of the Thailand Association for Printing Technology Promotion and Chairman of the Thai Printing Association, has employed graduates from the RIT printing programs. He feels that the RIT Program meets unfulfilled needs within the printing industry.

> *Nowadays, people with Pre-Press computer skills are in great demand. The training courses offered by computer dealers are too short, are only for buyers, and focus only on the specific software packages, not the whole system. This training program, however, is open to anyone and provides training at several levels. It provides an integration of theory and skills and directly hits the target of what the market needs.*

Mr. Phusit Duanguiyuan, President of Alpha Print Co., Ltd., is in the process of developing a new company. He not only looks forward to hiring grads from this program, but he intends to take it himself!

> *I've just started my own business in electronic printing. Trying to find a program that educates people in the way of [applied] practice ... is very difficult. I am quite sure that this program addresses my needs...*

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Manufacturing Technology

CAD/CAM, CIM, Programming & Industrial Hydraulics & Pneumatics

offered by

Applied Technology Centre
N. 3939 Freya Street
Spokane, Washington
U.S.A. 99207

THE PROGRAM

The goal of the Applied Technology Centre (ATC) is to meet the manufacturing technology needs of employers in the northwest United States. The ATC is anchored by the Rexroth Lab. Rexroth is a German manufacturer of hydraulic/pneumatic components for the fluid power industry. This lab is used for training full-time college students, Rexroth personnel, as well as other trainees from the private sector.

In addition to the hydraulic/pneumatic training, the ATC offers a variety of introductory through advanced levels of training in AutoCAD, SmartCAM, and Novell. As an authorized AutoCAD training site, classes include 3D, Design, and civil engineering applications. The ATC's SmartCAM program offers training in 3D machining, and advanced fabrication and turning. The hydraulics training includes all areas of maintenance, service, and repair. Design level courses are also available for servo and proportional, as well as hydraulic systems, and the ATC offers courses in Local Area Networks and three levels each of "C" and "C++" programming.

The ATC's success is dependent on its close relationships with employers, focusing on understanding and incorporating their training needs into the curriculum at or above industry standards. This is achieved in part through an advisory committee drawn from area businesses and industries.

• *success is dependent on ATC's close relationships with employers*

The Applied Technology Centre instructors are drawn from industry, and strong professional development programs ensure that their teaching is current with the most up-to-date practices.

THE DELIVERY

The ATC's programs are self-paced, characterized by open entry and exit. Classes are short-term in duration, and are designed to be high-intensity in nature. This type of programming ensures flexibility and is quite responsive to changing work schedules.

• *programming is quite responsive to changing work schedules*

High demand courses are offered quarterly. These are heavily subscribed to by local industry and business as well as the general public. The ATC also offers customized contracted courses, specifically designed to meet the most exacting needs of companies in manufacturing technology fields. Contracted courses may be held at the ATC

site or at the company's location. All the ATC courses include lectures, practical demonstrations and labs.

• *computer courses have been designed such that they may be delivered on-site or in a mobile training unit*

The ATC's hydraulic lab utilizes state-of-the-art, movable training benches to ensure that customers receive practical experience that is relevant to their work environment. Also, many of the computer courses have been designed such that they may be delivered on-site or in a mobile training unit (MTU), as well as in the ATC classrooms.

Day and evening classes are available through a quarterly scheduled sequence.

SPECIALIZED RESOURCES

The ATC's CAD labs are equipped with Gateway 2000 486DX-33C's (six with 8mb RAM and six with 16mb RAM), Nanao 17" high resolution colour monitors, and Summa Sketch II digitizers. As an authorized Autodesk Training Centre, the ATC runs AutoCAD Release 12 software.

The Novel training lab is equipped with 16 Gateway 2000 4DX-33V machines (8mb to 16mb of RAM), 14" Crystal Scan 1024 NI colour monitors, and the most advanced networking equipment available. The ATC is a Novell Education Academic partner (NEAP), and provides Novell equivalent contract training courses to business and industry.

The hydraulic lab contains nine state-of-the-art hydraulic test stands with components provided by companies such as Mannesmann Rexroth, Bosch, Pacific Fluid Power, and Spokane House of Hose. Professional courses through Mannesmann Rexroth are offered, as well as general academic courses. A pneumatic equipment partnership is being developed along lines similar to the present agreement with Rexroth.

UNIQUE ELEMENTS AND BENEFITS

• *instructors at the ATC continue to work in industry*

Instructors at the ATC are drawn from and continue to work in industry. This ensures that the trainees receive high quality instruction from faculty who are knowledgable in current industrial practices. When the high quality of the ATC's instructors is combined with the ATC's state-of-the-art equipment and continuously updated curriculum, the result is an effective and practical training program. The Centre's relationship with the Community Colleges of Spokane provides access to a variety of training programs, including self-help classes, counselling, tutoring, apprenticeship programs, management training and employment retraining.

DURATION OF TRAINING

Courses range from 16 to 60 hours in duration, and are taught in formats that vary from two to fourteen days in length. Two CAD and CAM courses are typically scheduled each week. These are four to six weeks in duration. Hydraulic and Novell networking classes are usually completed in one week or less.

PARTICIPANTS

Currently, the ATC enrols 60 to 80 students each quarter. All students attend part-time, and most hold full-time jobs. The majority of our CAD and CAM students attend evening classes. By contrast, most of the hydraulics and Novell classes take place in the daytime, and students are often on day-release.

ROLE OF PARTNERS

The Applied Technology Centre is supported by business, industry and educational institutes. The fifteen person advisory board includes representatives from area companies as well as several members of the Applied Technology Centre and Spokane Community College's administration, staff and faculty.

The ATC is endorsed by Autodesk, PointControl, Novell, and Rexroth Worldwide Hydraulics. These partners assist in providing the high quality training and education that has become a hallmark at the ATC.

TESTIMONIALS

Bob Cooper, President of the Spokane Area Economic Development Council, describes the contribution of the Applied Technology Centre to the Spokane area.

> *The Applied Technology Centre will assist in making Spokane a city of the future by helping in the recruitment of new industries to our region.*

And a local business leader, Bob Griffith, President of Accra-Fab, has said,

> *If a manufacturer is concerned about keeping a well-trained work force, training clients, or introducing the latest technological advances into their business, they should call the ATC.*

Terry Brown, C.E.O. of Community Colleges of Spokane, has said that,

> *The ATC epitomizes the community colleges' efforts to give people in northeast Washington accessible and affordable education opportunities in the fields of CAD, CAM, CIM, and hydraulics and pneumatics.*

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Manufacturing Technology

Associate in Applied Science Degree Program
Electro-Mechanical Technology

offered by

Black Hawk College
6600 34th Avenue
Moline, Illinois
U.S.A. 61265

THE PROGRAM

In 1991, Black Hawk College collaborated with John Deere & Company -- Harvester Works to develop the Electro-Mechanical Technology Associate in Applied Science Degree Program. John Deere & Company is an agricultural implement manufacturing company that employs about 35,000 workers worldwide. The Deere Harvester Works, a Deere unit consisting of three plants and employing about 3,500, manufactures combines, planters, heads and repair parts. This technical program was specifically designed for the Product Development Plant where workers design and test future products. This plant employs about 150 workers including 84 International Association of Machinists (IAM) members. Because the designing and field testing of future products requires a high level of skills in a number of areas, the General Supervisor of the IAM workers approached the College to develop the program.

• *this two-year degree crosstrains for the requirements of world class manufacturing*

This technical two-year degree crosstrains technicians, skilled trades and special skills persons for the requirements of world class manufacturing. Globally competitive manufacturers need master technicians who are flexible enough to accomplish a variety of different tasks. This 68 credit hour program emphasizes a fundamental understanding of electronics, mechanical technology, communication, mathematics and social sciences. The graduates of the program are, therefore, prepared to troubleshoot not only technical problems but also interpersonal, intergroup and organizational problems.

THE DELIVERY

This program was designed specifically for the employees at the Deere Harvester Product Development Plant; therefore, accommodating their work and travel schedules has been the primary requirement for scheduling and the delivery of the training. Product Development workers often travel to field test equipment and consult with other Deere technicians as well as customers. As a result, classes are scheduled on-site at the plant, with variable exit/variable entry opportunities, and/or through independent study arrangement.

The on-site delivery of instruction ensures that course content and laboratory equipment is relevant and practical since instructors use current industrial problems for

application exercises. For example, the computer-aided drafting classes taught on Deere computers with the company's software allows students to immediately apply their new CAD knowledge and skills at the workplace.

The variable entry/variable exit and independent study formats permit students to work at their own pace and accommodate the demands of work and travel. Students may start whenever convenient and finish the course when they have achieved the competencies and standards specified. This may lead sometimes to rather unusual faculty office hours; students may need to call their professor for consultation as late as 9 p.m.

In addition to this more customized delivery of instruction, Black Hawk College also offers traditional on-campus classes to accommodate more conventional students who are not yet employed by Deere but hope to be hired after graduation. A number of Deere employees also opt for these on-campus classes since the company gives them release time to attend. Needless to say, courses on campus allow for larger and more diverse classes and therefore richer peer group interaction.

SPECIALIZED RESOURCES

The college has been able to deliver this program without extraordinary investment of new resources. The Electro-Mechanical Technology program is, in fact, an innovative combination of already existing courses in mechanical technology, electronics, mathematics, science, English and psychology. No new laboratory equipment and/or instructional materials are required to support this program.

Deere Harvester's investment in release time, tuition and books has been considerable. The company has committed to pay incentives as outlined in the 1992 International Association of Machinists contract. Deere IAM employees/students who successfully complete coursework toward their Electro-Mechanical Degree receive "pay for knowledge".

• employees who successfully complete coursework receive "pay for knowledge"

UNIQUE ELEMENTS AND BENEFITS

Teamwork between Deere Harvester and Black Hawk College has characterized the program from the very beginning. The General Supervisor at the Deere Product Development Plant approached the College Dean of Science, Mathematics and Technology with the original idea. Next, Deere Training Coordinators, IAM union leaders and Black Hawk faculty worked out the details of the curriculum. Then, Deere implemented its 1992 contract with the International Association of Machinists to tie pay increases to skill increase and Electro-Mechanical Technology coursework. Now the General Manager of the Deere Harvester Plants has publicly proclaimed and published his intention of hiring Electro-Mechanical Associate Degree graduates for entry level positions at Harvester.

DURATION OF TRAINING

The Electro-Mechanical Technology Degree program is designed as a two-year 68 credit hour course of study. Full time students average between 16 and 18 credit hours per semester for four semesters. Black Hawk College semesters are 16 weeks in length; a one-credit hour course meets for 16 weeks with one hour of lecture or two hours of lab per credit hour. Usually the student must complete at least two hours of homework for each hour of class. Because the majority of students are pursuing this degree on a part-time basis, it may take as long as three to five years to complete the curriculum.

PARTICIPANTS

Eighty-one students are majoring in Electro-Mechanical Technology. The majority are pursuing the degree on a part-time basis. For spring 1994, 28 students enroled for 11 or fewer credit hours. Sixteen students enroled for 12 or more hours and are, therefore, full time students as defined by the College. Classes are scheduled during the day and evening, and the majority of students entering the program are high school graduates.

ROLE OF PARTNERS

• *Deere Harvester's commitment to hire graduates is used as a marketing tool*

Because Deere collaborated in designing the program to meet current and future manufacturing job requirements, the curriculum is relevant and directly tied to the job market. Moreover, Deere has committed considerable support and resources to the program - paying for employees' tuition, allowing release time for classes and granting increases on the salary schedule for successful coursework. Deere Harvester's commitment to hire Electro-Mechanical graduates is used as a marketing tool for advertising the program to the general public. Several other manufacturers have also endorsed the skills that students develop in this program.

TESTIMONIALS

Richard G. Kleine, General Manager of John Deere Harvester Works, has publicly endorsed the Electro-Mechanical program.

> *The Electro-Mechanical Technology in Applied Science Degree offered by Black Hawk College is a direct by-product of John Deere Harvester's vision of the future employee. It fulfils job requirements for both a higher level of technical knowledge and multi-faceted understanding and demonstration of group skills.*
>
> *The future employee of John Deere Harvester will require significantly more education in the areas of quality consciousness, critical thinking and group problem solving. We are very pleased with the tie-in to a four year college degree program for those that wish to pursue it.*

Another endorsement comes from International Association of Machinist coordinator, Brian Mumma, who praised the program saying, "This is job security. With

an education like this, we've got the ability to do anything."

The Illinois Community College Board selected the program for statewide honours awarding it one of three Workforce Preparation Awards in January of 1992. According to the Illinois Community College Board, this degree is one of the first of its kind and a model of excellence for the rest of the State.

In a January 31, 1994 Business Week article titled "The New Soul of John Deere", the Electro-Mechanical Technology program was cited for excellence. The inclusion of this educational program in the contract negotiation is praised as both innovative and exemplary.

• *the inclusion of this educational program in the contract negotiation is both innovative and exemplary*

Further endorsement comes from the Dean at Black Hawk who is responsible for the program, Dr. Duttaahmed, who observes,

> *In order to meet the current national needs for training and employment in high technology, it is imperative that we train technology students in electronics, including a solid foundation in electricity, and manufacturing processes with design and computer-based instruction in both these areas. The Electro-Mechanical Technology Program fulfils all the basic requirements. Also, the graduates of this program enjoy the opportunity to further specialize whether on the job or through baccalaureate level study.*

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U.S.A. 19063

THE PROGRAM

Delaware County Community College (DCCC) delivers a variety of joint training projects, within the U.S., in Latin America and overseas, often working in partnership with other training organizations. This particular partnership activity involved two U.S. Community colleges and a regional airline company in Latin America. The program was custom designed to meet the specific needs of the region/customer, as identified by a training development team representing the colleges and the airline. The first phase of this program has now been completed, and DCCC is discussing follow-up training as well as similar training delivered in other locations.

Delaware County Community College played the lead role in developing and delivering this training program. Located in Pennsylvania, just outside the city of Philadelphia, DCCC is located within a major transportation hub, thereby enabling its staff to travel quickly and efficiently to almost any training site. The second college involved in this program was Delaware Technical and Community College (DTCC), located in Dover, Delaware. The proximity of this college to Washington, D.C., also facilitated easy and ready access to international transportation. The regional airline in this program was TACA International Airlines, based in El Salvador.

The purpose of the program was to provide TACA field employees with expert, state-of-the-art training in aircraft maintenance and refurbishing. This training focused on the use and repair of composite materials, hydraulics, metallurgy, and airframes. With the development of this "in-house" expertise, TACA's maintenance costs were significantly reduced as was overall aircraft "downtime". Consequently, flight time increased and scheduling efficiency was boosted. Financial benefits were immediate.

• *financial benefits were immediate*

Training competencies for this program were developed, as were outcome standards, following a site visit by the Program Coordinator and Chief Instructor to the TACA repair and maintenance facility located in El Salvador. All competencies and outcomes were agreed to by the colleges and TACA prior to the implementation of the program, and these same measures were used to evaluate the training.

It is worthwhile noting that Delaware County Community College is a Total Quality Management (TQM) institution. The implementation of this management philosophy has ensured that the college develops cost effective training which meets the

needs of trainees and the sponsoring organizations. Also, faculty are selected for their experience in business and industry. This ensures that the training experience is relevant.

All training at DCCC is developed around three basic criteria:

1. Instruction has clearly delineated and measurable outcomes;
2. The training reflects high industry standards and incorporates problem solving as a key instructional tool;
3. Realistic work attitudes and habits are modelled by the instructional staff.

THE DELIVERY

The training was conducted at the DCCC campus just outside Philadelphia and at TACA's field repair centre in El Salvador. The location for specific training modules was based on the availability of necessary training resources, as well as costs. For example, the portion of the training related to composite material technology was completed at the DCCC site because it is one of the few locations in North America where the technology for instruction in this field is available. Instruction specifically related to airframes as well as training in hydraulics was conducted at the TACA site since this was the most cost efficient method to access the variety of TACA aircraft. Instruction was carried out by faculty from DCCC and DTCC.

Although the medium of instruction in this program was English, TACA supplied a translator to ensure that trainees clearly understood all the material.

SPECIALIZED RESOURCES

The partnership that formed the basis of this program was necessary in order to deliver the program at the standard required by the industry. Neither DCCC nor DTCC had the training resources to complete the entire program without assistance.

The key specialized resource that DCCC brought to the program was its composite materials technology laboratory. This equipment was established at the college several years ago through another joint partnership project, this one with Boeing Helicopter. The primary composite materials training instructor works full time at the college, while two additional instructors were "on loan" directly from Boeing. Using instructors from the Boeing facility ensured currency.

• the key resource that DCCC brought to the program was its composite materials technology laboratory

The airframe instructor was a specialist in that field, qualified to train according to FAA regulations and standards. This component of the instruction was completed in El Salvador.

In order to ensure compatibility with TACA systems and processes, the materials in the training program were supplied directly by TACA. In addition, TACA supplied all the tools directly from its inventory in El Salvador.

UNIQUE ELEMENTS AND BENEFITS

DCCC's experience in conducting out-of-country training proved particularly valuable in this program. The fact that the Program Coordinator had worked on many cooperative industrial training projects in different areas of the world ensured that project coordination details were appropriately addressed.

Also beneficial were the field visits by DCCC and DTCC to the El Salvador training facility, and visits by TACA staff to the training site at DCCC. This close communication permitted appropriate adjustments to be made to the training activities, smoothly and with a minimum of delay and intrusion.

By completing the training in composite materials technology at the DCCC site, the trainees had the opportunity to interact with a wide variety of American college students. This increased their cultural awareness and understanding of the U.S., a market that TACA expects to serve in the future. As a byproduct, there was an extraordinary increase in the trainees' ability to converse informally in English.

DURATION OF TRAINING

The duration of the program was established *de facto* through identification of the expected competencies. In total, the training activity encompassed seven major training elements, five of which were in El Salvador and two of which were in the U.S. Each training element lasted an average of four weeks, for a total of twenty-eight training weeks during a two year period.

• *the training days were quite long, frequently ten hours in duration*

The training days were quite long by typical postsecondary education standards - frequently ten hours in duration. Further, the instructors often met with small groups of students following the regular training day in order to review and emphasize key points.

PARTICIPANTS

More than sixty trainees participated in this program. All of these students had a technical school education through the high school level, or equivalent, and some held university degrees in technical subjects.

All of the trainees were TACA employees, some with years of experience and others who were relatively new to the organization. All were tested in English and hand-picked by TACA, and all underwent a short training and orientation activity prior to entering the program.

ROLE OF PARTNERS

The partnership basis for this program created a synergy that would have otherwise not been available. DCCC's expertise and resources in composite technology, combined with DTCC's hydraulics capability, and coupled with TACA's repair and maintenance facility, resulted in a strong cross-cultural training program with measurable financial benefits for the sponsoring organization.

In addition, Boeing's participation and commitment was a major strength in this program. Specifically, the involvement of their part-time faculty ensured program currency.

Training in El Salvador required hydraulic lab equipment that was not available through TACA. As a result, an arrangement was made with Universidad Don Bosco (San Salvador) to use their facilities and lab staff. As well, an agreement was reached with FEPAE (Fundacion Empresarial para el Desarrollo Educativo), an NGO training institution in San Salvador, to train one of their instructors such that a resident trainer would be available to TACA should updating or additional training in hydraulics be required in the immediate future. In this way, independent in-country training skills are a legacy of the program.

TESTIMONIALS

Leo Dominguez, Technical Coordinator for TACA, had this to say about the training program.

> *The relationship over the past two years has been much greater than expected and has allowed our airline to hire more people and advance more rapidly than if we had not been part of the partnership.*
>
> *The partnership has provided a high quality, cost-effective way for TACA Airlines to compete in a competitive, global market. The partnership is like having our own in-house training department.*

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Cedar Rapids, Iowa
U.S.A. 52406

THE PROGRAM

In 1986-87, Kirkwood Community College collaborated with local industries to develop a training program to produce a labour pool of skilled technicians qualified to assist in the automation of industrial food processing, manufacturing, and raw materials processing environments. Many local companies felt strongly enough about the need for trained industrial process control technicians that they assigned senior level personnel to assist the college in developing this program which, since its implementation, has done much to meet the collective needs of local industry.

Local companies that supported the development of this program included: Vector Corporation, Williamsburg Manufacturing; Goss Products Division, Rockwell International; Fisher Controls International; Victor Plastics; Crane Manufacturing Company; Cherry-Burell Corporation; Proctor & Gamble; Square D Company; Collins Aviation Group, Rockwell International; Norand Corporation; Quaker Oats Company; and Amana Refrigeration. Together, these companies represent a cross section of manufacturers in the area. Collectively, they employ approximately 11,800 people.

The industrial process control technology curriculum prepares technicians to apply the peculiar combination of skills necessary for working in the field of automation and process control. Manufacturers of food products, hard goods, and raw materials need technicians who are skilled in electrical, electronics and computer programming fields, and who can design, set up, troubleshoot, repair, program, and operate sophisticated, automated processing and production systems.

• *Capstone courses in this program integrate fundamentals*

Capstone courses in this program integrate fundamentals from the three major technical areas, requiring students to design and build an automated system within identified parameters and using equipment available in the shop. One class built pneumatic robots that are now used for instruction in the program. This group designed the mechanical configuration, electronic circuitry, and computer interfaces, built the sub-systems from scratch, and wrote the computer control programs that operate the robots. Another group, for their capstone course, designed a food processing machine that incorporates conveyors, robots, computers and sensors to apply hot butter, sugar and cinnamon to doughnuts. Again, the mechanical, electrical, sensor, and computer interface systems were designed and built by students. This group

also wrote the control programs and integrated a master computer to regulate the entire system. While enroled in the capstone course, students work in teams on each facet of the design. This approach promotes the development of teamwork, communication, negotiation, and management skills.

Graduates of this program are employed initially in food processing, manufacturing, and raw material processing industries as electricians or electronics technicians. Later they advance to become technicians who develop and support a variety of complex process control systems and equipment.

THE DELIVERY

The Industrial Process Control Program is a full-time, credit program delivered during daytime hours. All faculty members teaching in this program have a minimum of five years of industrial experience. The lead instructor was an electronics technician for Mostek in Dallas, responsible for final testing and product release for all the RAM chips, microprocessors, and logic chips manufactured by that company. He also worked for Honeywell as an electronics technician and taught in an automation program at another community college before being recruited by Kirkwood Community College.

Close interaction among students over the two year length of the program provides for collaborative learning experiences, teamwork, and projects that extend beyond one academic term.

SPECIALIZED RESOURCES

Traditional electrical and electronics instrumentation and test equipment is used in the program, as well as the following more specialized equipment: electric SCARA robots (these are Rhino robots with Mark IV controllers); pneumatic robotic systems (designed and built by the first graduating class); vision systems (these instruct students with regard to how vision data is utilized by computers to make decisions according to programmed parameters); American Merlin electric robot complete with controllers; Adept SCARA robot; Allen Bradley Vista 2000 area controller system; Allen Bradley PLC-5 programmable controller; Allen Bradley SLC-150 programmable controllers; Texas Instruments programmable controllers; and an infrared screen safety system.

Each student purchases components for and builds a microprocessor trainer/testing kit that is used to teach microprocessor programming. During the program, the students interface this device with other equipment to test systems and system components. Following graduation, this equipment becomes a critical part of the grad's tool kit and can be used to check computer equipment in all automated environments.

• a strong feature of this program is the philosophy of using real equipment and real situations for student learning

UNIQUE ELEMENTS AND BENEFITS

A strong feature of this program is the philosophy of using real equipment and real situations for student learning, as opposed to teaching "canned" systems. Faced with actual industrial examples, students must combine their creative and technical skills

to solve problems. There are no "plug A into B" cookbook answers, and students are forced to use available components to create solutions. Through experimentation and trial and error, students determine input/output requirements for automated systems. For example, when a group of students experienced a problem with sporadic malfunction of the pneumatic robotic systems, they applied experimental methods and critical thinking skills to discover that motors on the other side of the production area were generating magnetic fields that induced unwanted current in exposed wires. The students resolved this problem by electronically shielding the work area with grounded metal wall coverings.

A second strong feature of this program is the availability of expertise from faculty in a variety of program areas. Electronics, electricity, and manufacturing faculty teach classes and contribute their expertise to specific fields in the Industrial Process Control Program. This leaves the lead instructor free to concentrate on the advanced course work and the capstone courses.

A unique feature of this program is the capstone courses. It is at this stage in the program that students are required to integrate material from all the courses in order to solve industrial applications problems, either individually or as part of a team depending on the problem at hand. Specific problems and projects are not duplicated, so each group of students is faced with fresh questions that demand creative approaches and integrated solution sets.

DURATION OF TRAINING

The program is four semesters and two calendar years in length.

PARTICIPANTS

Over the past five years, one hundred and eighty-eight students have completed this program. Slightly more than one hundred and forty have been full-time students, and the rest have studied on a part-time basis. Approximately 90% of the students come directly from secondary school.

ROLE OF PARTNERS

• the program benefits from its relationships with industries in the area

The Industrial Process Control Technology program maintains an industrial advisory committee comprised of technicians and supervisors from the field of automation and process control. This committee meets a minimum of two times annually to discuss issues related to the program and make recommendations related to curriculum, equipment, job placements, and student progress. The committee also serves as a jury to provide feedback to students on their capstone projects.

The program benefits from its relationships with industries in the area. Many of these have donated equipment and expertise, and provided opportunities for field trips and work placements.

The program is articulated with the University of Northern Iowa (UNI). This

enables graduates of Kirkwood's Industrial Process Control Technology Program to enrol at UNI and complete a degree in Electromechanical Systems. The articulation agreement provides for acceptance of approximately 30-35 credits toward the baccalaureate degree.

TESTIMONIALS

Steve Ovel, former Executive Director of Economic Development at Kirkwood, has stated that the strong identification with local industry is a major strength of this program that pays dividends for the college, industry and the students.

> *The program faculty work very closely with persons who work in manufacturing processes in both the hard goods and food processing industries. In fact, the curriculum was developed in close co-operation with members of these industries and is largely based on observations of the instructor during his tours of their facilities. It is this realism in the approach to instruction that is a significant strength of the program. We are fortunate to have a program of this nature available to the constituents of our service area.*

Roger Gordon, former Head of Maintenance at Square D Company in Cedar Rapids and a member of the Program Advisory Council, has strong praise for the program.

> *We strived to make the instruction as close to reality as possible, and the products developed by the students, particularly at the end of the program, are strong testimony to the effectiveness of the course activities. I fully support the goals and objectives of the IPCT program and, as a result, my company, Square D, has donated hardware and software to the program each year for several years.*

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Automotive Technology
Chrysler, Mazda and Generic Training

offered by

Mt. Hood Community College
Engineering & Industrial Division
2600 SE Stark
Gresham, Oregon
U.S.A. 97030

THE PROGRAM

Chrysler and Mazda new car dealerships in the area served by Mt. Hood Community College – roughly, the metro Portland, Oregon region in the U.S. northwest – have for many years required a small but steady stream of qualified technicians to provide after sales service and repair. About five years ago, it became apparent to these manufacturers that demand often exceeded qualified supply, and that the resources of the local community college could be used to provide a more consistent stream of qualified technicians.

In other U.S. locations, Chrysler and Mazda have established full fledged independent training programs. However, demand for technicians in the Portland area does not merit large scale independent training programs. As a result, a three stream program was developed in order to serve several related needs.

The three program streams include: (1) a Chrysler Apprenticeship Program (CAP); (2) a Mazda M-Tech Program; and (3) a generic automotive service and repair program. Each year twenty-five students enrol in the two year program.

In the theory classes, all students, regardless of their stream specialization, receive the same training materials, accented with Chrysler examples to represent U.S. manufacturers and Mazda examples to represent Asian manufacturers. A single, generic, principal text book forms the mainstay of the written materials, with some Chrysler and Mazda training books provided as a supplement for those students who are specializing in either the CAP or M-Tech programs.

Both Chrysler and Mazda have provided the college with vehicles, training aids, supplemental training books and materials, and specialized tools and equipment that apply specifically to their vehicle lines. Consequently, during lab classes, students in the CAP program focus on vehicles and training aids from Chrysler, while those in the M-Tech program use Mazda vehicles and training aids. Students in the generic stream make use of a variety of vehicles and training aids.

Approximately 75% of graduating students specialize in the Chrysler program, 15% complete the M-Tech program, and the remaining 10% finish the generic program.

THE DELIVERY

Traditional theory classes include lecture, manufacturer-based slide and video presentations, textbook assignments, demonstrations, article reviews, manufacturers' reference book assignments, and generic worksheet assignments. Even in the lecture classes, the focus is on an applied, problem solving approach favoured by the manufacturers.

During lab classes, students complete manufacturers' worksheets on components, manufacturers' worksheets on vehicles, "live" repairs on vehicles, and Automotive Service Excellence (ASE) competency task worksheets.

Students in this program must complete out-of-class study tasks, including written summaries of every paragraph in their automotive theory textbooks. In this program there are nine major texts, totalling more than two thousand pages. In addition, each theory class is graded on homework, quizzes, and a comprehensive final examination.

• *students must complete written summaries of every paragraph in their automotive theory textbooks*

Lab competencies are checked using a fleet of thirty vehicles. Every major automotive system is represented in this grouping. Each automotive lab class has a practical final exam where students rotate from vehicle to vehicle to diagnose and solve problems.

The program also includes a variety of demonstrations, guest speakers, and field trips to local dealerships and other repair centres.

SPECIALIZED RESOURCES

In the 46,000 square foot automotive facility, Mount Hood Community College has in excess of $500K (U.S.) worth of automotive tools, equipment and supplies. In addition, Chrysler and Mazda have stocked specialty tools and equipment, vehicles, components, and training materials with a value of more than $650K (U.S.).

UNIQUE ELEMENTS AND BENEFITS

Having three training streams is an atypical program element. This allows the manufacturers to have dedicated training without each of them absorbing the full cost of a completely individualized training program. The result is lower cost for the manufacturers, lower cost for the dealerships, higher starting pay and more options for the students, reduced delivery costs for the college, and a pool of instructors with the latest technical training.

The close relationship between the college and the manufacturers and dealerships helps with job placements, and ensures that students have a realistic view of the occupation and employment opportunities well before graduation.

Students from Mount Hood Community College can block -ransfer to Northern Montana University and enter the Bachelor of Automotive Studies program with advanced standing.

DURATION OF TRAINING

The training program is two years in length. In the first year, three "quarters" of instruction is followed by fifteen weeks of automotive co-op work during the summer period. This sequence is replicated in year two of the program.

PARTICIPANTS

Approximately 92% to 95% of the participants are male. All are high school graduates. Their ages range from eighteen to fifty, with the average being twenty-four. All students attend classes full-time during the day. The college accepts twenty-five each academic year, for a maximum of fifty trainees at any one time.

ROLE OF PARTNERS

• *partnering with Chrysler and Mazda has brought numerous resources to the program*

Partnering with Chrysler and Mazda has brought numerous resources to the program. This includes up-to-date training for the instructors, paid co-op for students during the summer months when they are not in classes, reference materials and specialty tools for the program, vehicles and vehicle components, as well as marketing brochures and materials.

To date, the total value of industry contributions to this program is in excess of $500,000 U.S.

TESTIMONIALS

According to T. G. Young, Customer Satisfaction Manager for the Portland Zone Office of Chrysler Corporation, the "apprenticeship program is extremely beneficial" ... it produces "well trained entry level technicians".

The Chair of the CAP Advisory Committee, R. K. Adams, who is a technical advisor with Chrysler Corporation, describes the program as very responsive to the needs of sales and service dealerships.

> *MHCC faculty have been very responsive to our needs. As vehicles have become more complex, we have found it necessary to elevate student standards. Mount Hood Community College has responded by intensifying teaching and counselling efforts to ensure student adaptability at the dealership level.*

Chuck Hudson, Service Manager with Northwest Jeep/Eagle, has been very pleased with the quality of the graduates and students on co-op placement.

> *[We wanted to] let you know how pleased we have been with the CAP Program. Both full-time employees are working out very well, and we are excited [with the placement students].*

Jim Angel, Parts & Service Manager with Riverside Jeep/Eagle, has said that "we find the CAP graduates very willing to take on any task. [They] have the general knowledge ... and are eager to learn."

Teamwork is stressed in this program, as described by Mark Peterson, a recent graduate and employee of a local dealership.

> *The CAP Program at MHCC has helped me learn the importance of teamwork ... Teamwork is how things get done ... [and] ... it makes work a fun place to be.*

In addition to students from the northwestern area of the United States, the Automotive Technology program draws applicants from as far north as Alaska and as far south as California. Recently, there has been interest from overseas students. A student from Saudi Arabia has just completed the program, and a student from the P.R.C. is currently enroled.

The success of this program has led Chrysler to implement similar training programs at other colleges.

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Combined Welding/ESL Program

offered by

Mt. Hood Community College
Engineering & Industrial Division
2600 SE Stark
Gresham, Oregon
U.S.A. 97030

THE PROGRAM

• *this program removes the traditional step of requiring students to learn English before they begin their training in a skilled trade*

The Welding/ESL Program at Mount Hood Community College has been designed to combine basic skill training in welding with English skills for Hispanics in one instructional package. This program, as designed, removes the traditional step of requiring students to learn English before they begin their training in a skilled trade.

The program also ensures that the entire English language training focuses directly on technical competency pertinent to the trade. This is possible because, unlike most ESL training programs, these training groups are homogeneous insofar as their vocational orientation is concerned. Using the welding terminology and jargon of the trade, English lessons are given to the students by an ESL teacher that developed the lesson material by sitting in on the welding classes. The welding instructor is bilingual in English and Spanish, and is able to give lessons germane to welding technology using both languages as necessary.

The students are introduced to welding technology during the first quarter with oxy/fuel cutting, carbon arc cutting and shielded metal arc welding (stick electrode welding). The second quarter includes the wirefeed processes, gas metal arc welding and flux cord arc welding. During these two terms the students are instructed in and practice the safe use of the processes in all welding positions. The welder qualifications test that is given in the third quarter requires that all students be proficient in these processes by demonstrating the ability to weld in the vertical and overhead positions to a standard set by the American Welding Society structural welding code D1.1. Also, during the third quarter, the students study blueprint reading for the welding industry.

THE DELIVERY

The students attend the welding portion of the program for eight hours per week, two evenings from 6 p.m. to 10 p.m. Two hours per week are dedicated to classroom work, while the remainder is lab work. All technical terms are given in English only, though Spanish may be used to explain concepts or provide specific feedback to individual students. In addition to the eight hours of welding, three hours per week of English language instruction is provided.

SPECIALIZED RESOURCES

The welding labs are outfitted with standard welding apparatus, individualized such that each student has his or her own working area. Since worker safety is critical, the lab is equipped with forced ventilation, eye protection devices and ultra violet screening equipment. All students are required to wear appropriate clothing, and the equipment is the same as that used in industry. Visits to potential employment sites are included in the program in order to provide the student with a clear understanding of the worksite and a better appreciation for the metal trades industry.

Before the formal welding training begins, the students complete four weeks of life skills training. The focus of this element of the program is to provide the students with attitudinal and skills training necessary to succeed, both in the training program and on the job. Included in this part of the training program are elements such as attendance, punctuality, work attitude, commitment to the program or job, as well as other factors such as getting to school, bus routes, job applications, resumes, interviewing, emergency procedures, and safety.

UNIQUE ELEMENTS AND BENEFITS

The key ingredient that makes this program unique is the combination of practical skill training in welding with English language training. In this area of the U.S., it is difficult to get a job as a skilled worker unless basic English skills have been mastered.

By combining English instruction with skill training in welding, students progress faster and more directly to their goal - a good paying job within the mainstream economy, including opportunities for advancement and mobility.

An important secondary element in this program is the use of a Spanish speaking instructor. This allows for Spanish language intervention when a concept is not clear or if a safety issue arises and the need for immediate and clear communication is imperative. The language facility of the instructor appears to provide a greater level of comfort for the students, many of whom, though they have been in the U.S. for up to eight years, still have little facility with English because they live in a totally Spanish-speaking environment.

• *the language facility of the instructor appears to provide a greater level of comfort for the students*

The program has a placement and job retention rate of 80%. This is considered to be exemplary for the program type and economic conditions in the region. Employers, advisory committee members, faculty and students consider this to be a strong indicator of the program's quality.

DURATION OF TRAINING

The training program is three semesters or quarters (nine months) in duration. Students receive lab instruction in welding two nights a week for a total of eight hours per week. In addition, there are three hours per week of English instruction.

The total hours of welding training meet the standard for industry certification.

There has been some pressure to reduce the training period, but the college has continued with this format in the belief that any reduction would seriously affect the quality of the program.

PARTICIPANTS

To date, the program has graduated three classes of 20 students. The number of graduates reflects demand from within the Hispanic community as well as placement opportunities. All of the program participants immigrated to the U.S. from Mexico. The average student has been in the U.S. for six years prior to enroling in the program. A requirement for entry into the course is literacy in Spanish at the grade six level; however, most participants have some speaking and writing ability in English. The age range is 22 to 40, and 10% are female.

ROLE OF PARTNERS

One of the primary reasons for the success of the program has been the partnership between Mt. Hood Community College and The Private Industry Council (PIC). The PIC's role has been to screen the applicants, provide the life skills training, and do the job placement and follow-up. During the training a PIC representative is available to the students and program staff to aid in solving any problems that may surface at either the program or student level. The availability of a PIC representative has proven to be an excellent student support, and has definitely contributed to the high retention rate.

• *factors promoting a high placement rate include the screening process and the orientation sessions*

The program's placement rate is unusually high for this type of training. Factors promoting such a high placement rate include the screening process and the orientation sessions, during which the potential participants are provided with accurate descriptions of the nature of the metal working industry and job prospects. Also helpful are the presentations given by graduates. These emphasize the commitment necessary to complete the program and the benefits of the training. PIC employs a job placement counselor to work specifically with this group, and if a graduate faces a layoff situation the placement service will attempt to find a new job opportunity within the field.

The PIC provided 50% of the funds for the program. This has increased the accessibility of the training, particularly for economically challenged Hispanics.

TESTIMONIALS

Carol Snyder, Program Director at PIC, had this to say about the program.

> *The sense of pride and accomplishment [Welding/ESL graduates] feel is a tribute to this unique [training] effort. We consider the Mount Hood Community College/Private Industry Training Council project to be a perfect example of our agency's partnership goals and mission statement - "to promote individual self sufficiency and a skilled workforce by eliminating barriers to productive employment".*

Vern Porter, instructor for this program, is very enthusiastic about the results.

> *I see the results of the program. In nine months, people who have been earning the minimum wage, and who have had little in the way of future prospects, can get a job with a solid future and good pay. One student in particular comes to mind. She is a single mother with three children who after completing this program got a good job with a rail car manufacturer. Before the program she lived a life characterized by short term minimum wage jobs. Now she is living in her own house.*

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